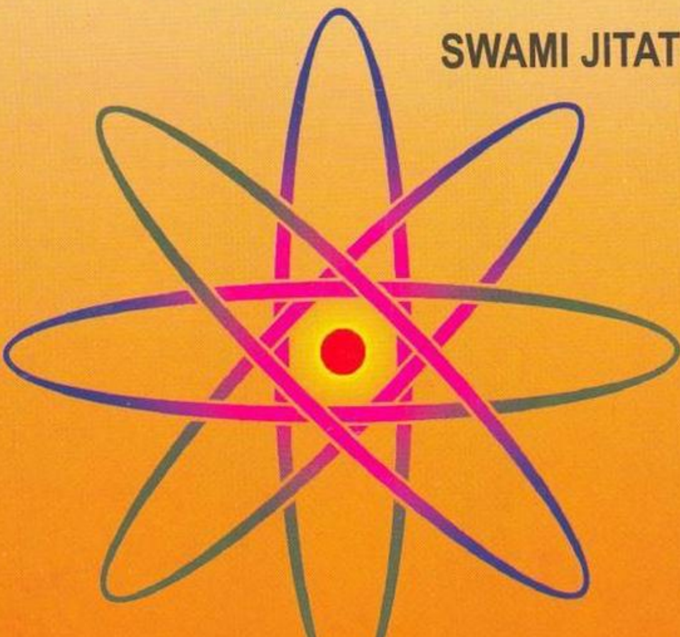
MODERN PHYSICS AND VEDANTA

SWAMI JITATMANANDA

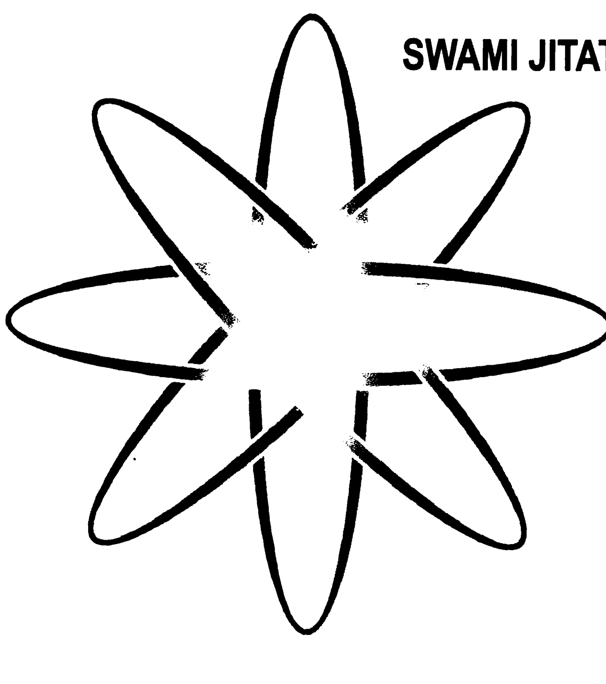


Bharatiya Vidya Bhavan

BHAVAN'S BOOK UNIVERSITY

MODERN PHYSICS AND VEDANTA

SWAMI JITATMANANDA



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FOREWORD TO THE FIRST EDITION

This book on '**Modern Physics & Vedanta**' is written in the old Hindu tradition where its philosophy has been constantly modified over the ages in the light of social and intellectual changes of the day. Since Vedic times our thoughts have been influenced by social and political conditions and more recently by the impact of the rational sciences.

Swami Vivekananda insisted that Vedantic thought was not inconsistent with science and the two should go hand in hand since then science and scientific thoughts have progressed enormously and taken very different directions. The discovery of quantum mechanics and relativity have shaken the very foundations of epistemology. In spite of these violent changes it is only Vedanta which seems to be in a position to absorb the tremendous impact of the new science.

In this small book of 96 pages, the learned author, who is both student of science as well as philosophy, has packed in an unbelievable amount of information on these subjects. The density of information is indeed startling. A student of both these fields of knowledge will appreciate the attempt at unification that

has been brought about. Anybody who studies this book should be able to feel the mystic nature of physics. Of course, it is fashionable among physicists to avoid the mystic implications of modern physics and consider those who do so, as crazy people. But nobody can deny that problems are not there. Swami Jitatmananda's book brings out powerfully how the developments of physics and the philosophy of Vedanta are indeed interconnected. It is clear that more books with detailed explanations will have to be written on the subject to constitute what we can call modern philosophy. I can hardly call this book only an introduction to the subject since it has packed with information in a very scholarly way. It is both accurate and complete in its own way. I believe it is of great significance to the development of philosophy suitable for the modern world.

(Raja Ramanna)

PREFACE TO THE FIRST AND SECOND EDITIONS

This book *Modern Physics and Vedanta* is a collection of seven articles published in *Prabuddha Bharata,* the monthly English journal of the Ramakrishna Math and Mission.

Discoveries in modern Physics, especially the discoveries from the beginning of 20th century, are making it more and more evident that many of the conclusions of Modern Physics are exactly the conclusions of Vedanta philosophy enshrined in the Upanisads and countless other Vedantic texts.

Swami Vivekananda, the first great exponent of Vedanta philosophy in Modern times, had explained, during the last five years of the 19th century, the ancient truths of Vedanta in a language which would be acceptable to modern scientists and rationalists. Subsequent discoveries in Physics show how infallibly he interpreted the eternal truth of Vedanta in Modern English language. Many western physicists like Heisenberg, Schrodinger and others have been aware of these parallelisms. This small book is a very humble attempt to project how some of the conclusions of modern physics converge with the very words and ideas of the ancient Vedanta, and its modern interpretations given by Swamiji.

I am deeply grateful to Revered Swami Ranganathanandaji for his encouragement behind this work. He kindly made available to me his personal collection of relevant books on this subject. I am also grateful to Revered Swami Hiranmayanandaji, General

Secretary of the Ramakrishna Math and Mission, for his kind permission to publish this book.

I am beholden to Dr. Raja Ramanna for sparing time, amidst his several pressing preoccupations, to read this book and write a Foreword in his characteristic inimitable style.

Finally, my deep gratitude goes to Shri S. Ramakrishnan, Secretary, Bharatiya Vidya Bhavan, who took all the interest to publish these articles in a book form, and took all the trouble to expedite the publication.

– Swami Jitatmananda

PREFACE TO THE THIRD AND FOURTH EDITIONS

Seventeen years have passed since the first edition of "**Modern Physics & Vedanta**" was published in 1986, with an extremely encouraging foreword by India's eminent atomic scientist Dr. Raja Ramanna. Since then many books on the importance of mysticism and consciousness in physics have been produced. Books like Fred Allan Wolf's *"Taking the Quantum Leap"* or Amit Goswami's *"Self Aware Universe"* have reinforced the supremacy of consciousness over matter.

During the last seventeen years these thoughts have aroused a lot of interest and queries, whenever and wherever I tried to expose them in various cities like London, New York, Berkeley, Sacramento, Hollywood, Sydney, Melbourne, Perth, Kuala Lampur, Singapore, Fiji, Colombo, and the major Universities of India.

But perhaps the most rewarding experience was an illuminating and kind letter (produced overleaf) of appreciation of the book from *Prof. John A. Wheeler* which unexpectedly reached the author in 1999. Subsequently on Prof. Wheeler's invitation, I met him in his Princeton residence on 7th Jan, 2000, and had a 90 minutes' conversation on the subject of physics and philosopyhy. It was during this conversation that Prof. Wheeler offered his deep conviction of the fundamental equation ($i^2=j^2=k^2=ijk=-1$) about electron, which inspired further introspection and study, as a result of which the epilogue of

nearly 50 pages is attached at the end of this book. The author feels extremely grateful to this historic personality and saintly stalwart of modern physics, who worked with Niels Bohr and others of the great generation of physicists.

My deepest gratitude goes to Shri S. Ramakrishnanji, Head of Bharatiya Vidya Bhavan, whose constant encouragement and appreciation of my little work, brings out this present edition with the new epilogue. If the reader feels a little more encouraged to accept the truths of Vedanta, this work will find fulfillment.

– **Swami Jitatmananda**

CONTENTS

1

WHITHER PHYSICS TODAY?

TO answer the question, 'Whither Physics today?', we have to look at the phenomenal progress made by physics right from the beginning of this century to the present day.

Round about the 1920s, physics broke its three-hundred-year old slumber and its complacent dreaming of a 'mechanomorphic' universe, a universe moving unfailingly like a machine in perfect order. Physics entered the macro-universe of Einstein's Relativity, and then the micro-universe of Heisenberg's Uncertainty. At the macrocosmic level physicists today have taken visionary flights far beyond the imagination of poets. From the beginning of 1983, physicists have begun even to construct a picture of our universe immediately after 10^{-43} seconds of its birth in the Big Bang. Blackholes and white holes are emerging more powerfully in this world-picture. At the microcosmic level the atom, the *'atomos'* of Democretus, the hard material, the unbreakable fundamental of all matter has already dematerialized into more than two hundred sub-atomic objects. Physicists are hesitant to call these objects 'particles' any more. They are better described today as 'events' in the sub-atomic world, or 'interconnected patterns of dynamic energy' as physicist Fritjof Capra likes to call them. Some of these particle-events are as short-lived as two to three particle-seconds, one particle-second being 10^{-23} second. These particles have also emerged as 'waves', waves which are more unreal than real.

From the 'probability-wave' concept of Max Born has emerged a new speculation that photons and electrons may be 'conscious' or 'organic'. The Copenhagen interpretation of quantum physics and the Everett-Wheeler interpretation pointed to the idea that the external universe is a creation of our mind. To quantum physicists the universe is slowly appearing as an 'omnijective universe', a combination of the subjective and objective. A scientist is no more a detached observer but is an active participator in the very processes of his experimentation. Physics has already entered the areas of Eastern mysticism. Space which appeared as curved in Einstein's Relativity, appears today as 'the seat of most violent physics', as physicist John Wheeler says.[1] The impact of this new physics on the Western mind is already being felt. 'How the omnijective nature of reality will change Western civilization remains to be seen. The only certainty is that the changes will be stupendous....', writes Michael Talbot.[2]

'We are in the wake of a physics revolution', writes the Rockfeller University physicist Heinz Pagels in his latest publication on the frontiers of modern physics entitled *The Cosmic Code* (Quantum Physics as the Language of Nature) published in 1982, 'comparable to the Copernican demolition of the anthropocentric world - a revolution which began with the invention of the theory of relativity and quantum mechanics in the first decades of this century....'[3]

The superabundance of knowledge about the universe is raising an ever-increasing number of more intricate questions, whereas the language of ordinary life is becoming less capable of describing exactly what the scientists are observing or discovering

1. Quoted in, Heinz Pagels, *The Cosmic Code* (New York: Bantam Books 1983) p. 243
2. Michael Talbot, *Mysticism and the New Physics* (New York: Bantam Books, 1981) p. 17
3. *The Cosmic Code* p. 310

in experiments. The sub-atomic world is, as Einsten said, like an 'unopenable watch' where we can see the pointers move on the dial, but can never know the exact mechanism underneath. The eminent physicist John A. Wheeler in a recent interview remarked. 'Increasing knowledge of detail has brought an increasing ignorance about plan.'[4] Physicist Pagels writes, 'By the nature of phenomena it studies, science has become increasingly abstract. The Cosmic Code has become invisible. The unseen is influencing the seen.'[5] But since the 1970s physics has slowly started moving towards something profoundly simple and unifying. The destination of most theoretical physicists today is the 'grand unification' dreamed of by philosophers and saints millenniums ago. In the same interview mentioned above, Physicist Wheeler said: 'We find the world strange, but what is strange is us. It seems to me that we don't yet read the message properly, but in a time to come, we will see it in some single simple sentence.'[6] the grand unification that physics contemplates today is not merely a unification of mass and energy, nor a mere unification of different kinds of cosmic forces, but for the first time in the history of science, it is going to be a unification of mind and matter, subject and object, scientist and experiment. That is what Wheeler means by 'What is strange is us.'

Physicists are heading towards this vision of unity not under the influence of any philosophy or religion, ancient or modern, but by the impact of the results obtained in their experiments. Increasing knowledge of both the microcosmic world of atoms and nucleus and the macrocosmic world of blackholes have made physicists aware that they have to move deeper into the origins of the universe and still deeper into the way of how consciousness is related to this universe.

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4. *New York Times Magazine,* 26 September 1982, p. 38
5. *The Cosmic Code* p. 310-311
6. *New York Times Magazine,* 26 September 1982, p. 70

The first of these efforts has led to the latest unified theories in physics. The second one is leading another group of physicists to relate psychology and biology with physics. The urgency felt of late for the unified field theories is in a sense a result of the frustration of physicists in their chase for the ultimate building block of matter. 'Atom or '*atomos*' which was thought by Democretus to be the ultimate building block of matter, has today dissolved into more than 200 sub-atomic particles of three varieties, called 'up', 'down', 'strange', 'charmed', 'bottom' and 'top' quarks. In order to hold these quarks together physicists today are speculating on the existence of another sub-atomic particle called 'gluon'. Physicists are wondering about the end of this chase for the ultimate building block of matter. Mathematician Paul Davies of New Castle University said, 'Does not such proliferation of quarks and gluons make nonsense of the claim that they are elementary particles?'[7]

Here comes the consoling message from the proponents of unified theories. They think that simplicity in physics may not probably be gained by the search for the ultimate particle, but it may be gained by discovering, if possible, a single force out of which all the other forces in this universe have been made. Albert Einstein was the first dreamer of this unified-field theory. But he failed. One reason of his failure is that he did not incorporate the fundamental quantum principle of the 'uncertainty' of our knowledge of subatomic-particles. Today's unified field theories have included this and other quantum principles which have, in fact, become quantum laws.

The world of physics today deals with four kinds of forces: Electromagnetic forces (In 1864 physicist Maxwell established that electricity and magnetism are two aspects of the same force), Strong Interaction forces which bind the nuclear particles together

7. ibid.p.44

in nucleus, Weak Interaction forces which are responsible for the emission of nuclear particles from a radio-active element, and finally the force of Gravity. In the 1960s three physicists, Aldus Salam, Steven Weinberg and Sheldon L. Glashaw, formulated the idea of 'Electro-weak' forces which brought the unification of electro-magnetic and weak interaction forces. They were awarded the Nobel Prize for the work in 1979. Today physicists like A.R.Polyakov of U.S.S.R. and Gerard Hooft of Netherlands suggest that a superior force that could bind the electroweak and the strong interaction forces was created when the universe was in its infancy after the Big Bang. This grand unification of the electroweak and strong interaction forces presupposes the existence of a strange kind of object in the early stage of our universe called the magnetic monopole. In February 1982, a young physicist named Blas Cabrera of Stanford University, California, claimed to have indeed detected the existence of magnetic monopole.[8] All the force except Gravity are under the process of 'grand unification' today.

The force of gravity is still left out of this 'grand unification'. Physicists are, however, dreaming of a 'Super-unified Quantum Theory' which will not only integrate even gravity into the one primeval force, but also offer a picture of the first few moments of the creation of the universe by a Big Bang of a super-dense supernova. Stephen Hawking, the celebrated astro-physicist of Cambridge, thinks that this super-unification of the forces of the universe, is the most outstanding problem in theoretical physics at the present time.'[9]

The search for the beginning of the universe has become a passion with many physicists today. They feel that if once the picture of the very first instant of the Big Bang could be

8. ibid.p.40

9. ibid.p.69

reconstructed, then the whole problem of 'super-unification' would be complete, because the very picture of the first moment would offer a clear picture of how from one single force all other forces were created. The search for blackholes (to which Stephen Hawking had made an outstanding contribution by taking the first real photograph of a blackhole's existence in Cygnus constellation in 1974) is helping the physicists to form a picture of the Big Bang.

One of the main obstacles to the acceptance of the Big Bang theory was the idea that the universe is eternal, because protons the hardest constituent of our universe, was supposed to be eternal and undecaying. But this stumbling block is gone today making the path to grand unification open for the physicists. About 1960s, Soviet physicist Andrei Sakharov independently predicted that protons too decay. Today physicists working in the deep recesses of the Kolar gold mines in India, in the tunnel beneath the Mont Blanc, and under the salt mines on the shores of Lake Erie in Cleveland, U.S.A. have finally confirmed that protons indeed decay. Their life according to the latest calculation is 10^{32} years - a thousand billion billion times the present age of the universe.[10]

Roger Penrose of Oxford and Stephen Hawking of Cambridge have already opened wider horizons of the first moment of cosmic creation to physicists today. And 'Stephen's genius', said William Press, the Harvard physicist, is in piercing through to the solution without having to calculate non-essential pieces. [11] The problem of super-unification is 'quantizing gravity', and William Press believes that Hawking will come out successfully in the achievement of the grand unification primarily because he has taken to the path of what Einstein called the 'intuitive leap.'[12]

10. ibid.p.46
11. *New York Times Magazine,* 23 January 1983, p.64
12. ibid.p.64

What is the final vision of the world emerging out of today's physics? In very many ways the emerging picture compares more increasingly with the Indian concepts of Kalpa, or cycles of creation and the Vedantic theories of Brahman, the Conscious -Knowledge-Bliss Absolute, as the eternal substratum and source of all creation. But it has hardly any affinity to the concepts of creation in the Judlo-Christian tradition. 'The Big Bang may not be very like Genesis, but at least you can regard it as a creation, and you can involve God as a Creator', says Hawking.[13]

How does the universe run? The uncertainty principle of Heisenberg in 1927 totally denied the existence of a purely deterministic and casual universe running mechanically like a machine. Uncertainty or indeterminacy was found to be the very foundation of quantum physics, or the physics of sub-atomic particles. Today, in the 1970s, a successful verification of Bell's theorem by David Bohm in London, and by Clauser and Freedman in California, have confirmed that underlying far deeper the quantum chaos there lies a unity, a fundamental interconnectedness in the whole universe. 'Bells' Theorem is the most profound discovery of science', wrote Henry Stapp of U.S.A. Atomic Energy Commission in a recent interview published in January 1983.[14] Hawking admitted, 'It seems very reasonable to suppose that there may be some unifying principles, so that all laws are part of some bigger law. So what we are trying to find out is whether there is some bigger law from which all other laws can be derived. I think you can ask that question whether or not you believe in God.'[15]

The entire world of modern physics is moving towards a knowledge of final unity in the universe. The Vedanta, the

13. ibid.p.53
14. Cited in Gary Zukav, *The Dancing Wu Li Masters* (New York: Morrow Quill Paper Back edition, 1979) p.314
15. *New York Times Magazine*, 23 January 1983, p.53

philosophical and the metaphysical portion of the Vedas, affirmed this unity as the very basis of all existence and the ultimate goal of all knowledge. And for the first time, this unifying message of Vedanta was given to the Western world of science and technology, in the very language of today's physics, by the Hindu monk Swami Vivekananda as early as the 1890s. Today's discoveries in physics are in many ways approaching the very ideas he logically presented to the West. In his very first appearance on the Western scene in September 1893, Vivekananda highlighted the future unification of Western science and India's Vedanta philosophy. To the august assembly of Westerners gathered at the Parliament of Religions of Chicago held in 1893, Vivekananda declared:

Science is nothing but the finding of unity. As soon as Science would reach perfect unity, it would stop from further progress because it would reach the goal. Thus Chemistry could not progress further when it would discover one element out of which all others could be made. physics would stop when it would be able to fulfill its services in discovering one energy of which all the others are but manifestations. And the science of religion would become perfect when it would discover Him, who is the one life in a universe of death, Him who is the constant basis of an ever-changing world, one who is the only Soul of which all souls are but delusive manifestations. Thus is it through multiplicity and duality, that the ultimate unity is reached. Religion can go no further. This is the goal of all Science.[16]

The confluence of modern physics and the idea of Vivekananda Vedanta is an important field of study in modern times to which an increasing number of thinkers are slowly turning their attention. In the succeeding chapters we will try to read this fascinating story.

16. *The Complete Works of Swami Vivekananda* (Calcutta: Advaita Ashrama. 1977) Vol.1,p.14-15

2

VIVEKANANDA INTERPRETS VEDANTA TO THE WEST

WHEN, as an unknown monk, Swami Vivekananda left the shores of India in 1893 on his historic travel to America, neither the West nor the East was conscious of the new chapter that this unidentified prophet was going to open in the history of mankind. Even today nearly a hundred years after his first landing in the West, the nature and extent of Vivekananda's impact on Western thought and life are hardly clear to us. History says that a Pauline type of spiritual invasion takes at least a few centuries to receive acceptance from the world. The Roman Empire which crucified Christ in 33 A. D. had, in the long run, to surrender to His message of Love, and by 300 A.D Christianity became the state religion of Rome. Here now, for the first time in the history of mankind, a prophet from India was carrying the message of the Orient to the far West, to the continents of Europe and America.

Why did Vivekananda go to the Western people and preach the ancient message of India in their language, English, using their frames of thought like science and logic? He only fulfilled the divinely ordained purpose, the divinely chosen mission, that the forces of history had imposed upon him. To put it plainly, like Paul carrying the message of Christ from the world of Jews to that of Gentiles, Vivekananda was born to carry the ancient

message of India to the West. That was, and still is, the need of the West, and he was born to satisfy that need. Vivekananda was fully conscious of the historic role he was destined to play. At the Brooklyn Ethical Society, U.S.A., when someone pointed out that Hinduism was not a proselytising religion, he replied 'I have a message to the West as Buddha had a message to the East.'[1]

He made the people of the West feel that here was a prophet who came not to proselytize but to help, not to convert but to transform, not to subdue but to elevate, not merely to preach but also to live the great philosophy and also to help them live it. He came not with the jingoistic pride of a particular national culture with its rituals and symbols but as a worshipper of the undeniable divinity in man, the ever present infinity of knowledge, bliss and life which Vedanta finds at the core of every living being. He came not to a foreign land, but to his own 'sisters and brothers' who had for centuries remained bound by the dogmas of 'original sin' and 'hell-fire', deprived of the knowledge that they themselves contained the infinity of Godhead. Vivekananda's passionate plea at the Chicago Parliament of Religions is unforgettable - 'Allow me to call you, brethren, by that sweet name, heirs of immortal bliss.' Among Englishmen he found the best specimens of humanity with great integrity of character and unflinching devotion. Among Americans he found 'living Vedantins', not just talkers of Advaita. Of the nine active years of his life he spent more than five in the West. He knew the parched soil of the West was waiting for a shower. He brought the shower of love and sacrifice and sowed the seeds of Vedanta - the omnipotence, the omniscience, the ever-present holiness and divinity in all beings.

He went without the least trace of ego, floating on the mercy and guidance of the Lord. He went as a messenger of God. He

1. *The Complete Works of Swami Vivekananda* (Calcutta: Advaita Ashrama, 1973), Vol.5,p.314 (Hence Complete Works.)

went with the intellect of Śaṁkara, the heart of Buddha and the burning power of God-realization of his master Ramakrishna. His watchword was - 'The goal is to manifest the divinity within.....Books and temples and churches are but secondary details.' For him the world was not, only God was, and all that was, was permeated with God. One of his admirers, the great psychologist and philosopher of the 19th century America, Dr. William James found in Vivekananda 'an honour to humanity'.

In the late 90s of the 19th century none was more conscious or concerned than Vivekananda with the clouds of storm that were gathering on the horizon of the West which was dreaming of making the earth a materialistic heaven. In 1897 after his triumphal return from the West he pointed out to Indians, 'The whole of Western civilization will crumble to pieces in the next fifty years if there is no spiritual foundation....And what will save Europe is the religion of the Upanisads.'[2] Vivekananda entered the Western arena when the old order was yielding place to a new one. It was a period of a great transition in the worlds of both science and religion. With Darwin's discovery that man came not from Adam and Eve but from apes, the entire theological edifice of orthodox Christianity was shaken to its foundations. In the later half of the 19th century Western civilization was passing through an agonizing period of incertitude. A new life-giving philosophy of reason was yet to be born, while the old faith in a Church-dominated religion and an extra-cosmic God had lost credibility for the ever-growing number of rationalistic people. It was a time, as Vivekananda said, 'When the sledge-hammer blows of modern antiquarian researches are pulverizing like masses of porcelain all sorts of antiquated orthodoxies, when religion in the West is only in the hands of

2. *Complete Works* (1973), vol.3, p. 159

the ignorant and the knowing ones look down with scorn upon anything belonging to religion.'[3]

In short, it was a period of intellectual ferment and spiritual crisis in the West. While the 'ignorant ones' tried to cling fanatically, even in the wake of iconoclastic and rationalistic sciences, to the old order, the 'knowing ones' began to search for peace and consolation in other philosophies. Scepticism became the go of the day with the Western intellectuals. Millions left the Church which failed to satisfy scientific reason. Many surrendered themselves to Schopenhauerean pessimism and waited in utter existentialist morbidity for an end to life which was ruled, according to Schopenhauer, not by a providential God, but by a 'blind will' that created both good and bad alike with an irrational indifference. Many, again, surrendered themselves to Kantian agnosticism which rested complacently on the assumption that the ultimate Reality was unknown and unknowable to the mind of man. But the large majority of Western people went straight to the new glittering world of material wealth and prosperity which the age of Newtonian science and Industrial Revolution promised to them. The emerging technology became synonymous with science. Technological advancement which brought unprecedented industrial wealth for the first time in both Europe and America arrogated to itself the sanctity of science. Its object of worship was matter or, more precisely, gold and worldly enjoyments. Its crowning title became scientific materialism. The true spirit of science, which is essentially a search for truth and reality, was for the time being relegated to a secondary position. Vivekananda foresaw the tragic end of dollar worshipping science and cautioned the West in California, 'Thinkest thou of matter; matter thou shalt be'.

3. *Complete Works* (1973), vol.3, p. 110.

Vivekananda knew fully well that traditional religious sentiments would not hold water with confirmed materialists and rationalists. What they wanted was reason. In his speech of *The Absolute and Manifestation* delivered in London in 1896, Vivekananda declared openly:

Materialism prevails in Europe today. You may pray for the salvation of the modern sceptics, but they do not yield, they want reason. The salvation of Europe depends on a rationalistic religion, and Advaita - the non-duality, the oneness, the idea of the Impersonal God - is the only religion that can have any hold on any intellectual people. It comes whenever religion seems to disappear and irreligion seems to prevail, and that is why it has taken ground in Europe and America.[4]

But the task was not easy. It was in 1896 that Swamiji met Nikola Tesla, the most successful electrician-scientist of America in those days. In a letter to E.T.Sturdy dated 13 February, 1896, Swamiji wrote:

Mr. Tesla was charmed to hear about the Vedantic Prana and Akasa and the Kalpas which according to him are the only theories modern science can entertain....Mr.Tesla thinks he can demonstrate mathematically that force and matter are reducible to potential energy. I am to go and see him next week, to get this new mathematical demonstration.[5]

But Tesla failed to keep his promise, and Western science had to wait for ten more years for the rise of Albert Einstein to realize the oneness of matter and energy and the formulation of the 'Field' concept of force.

Vivekananda was persistent in his attempt to preach Vedanta in the language of Western science, although 'it had been a terrible struggle', as he said. The West looked upon the

4. *Complete Works* (1976), vol.2, p. 139
5. *Complete Works* (1973), vol.5, p. 101.

slumbering India, quietly suffering under foreign domination for hundreds of years, as a heathen land where religion and philosophy were synonymous with snake-charming, widow-burning, arrant superstitions and unimaginable idolatry. Moreover the largest majority of so-called Western intellectuals were not even acquainted with the bare principles of Indian thought like Ātman, Māyā, Jīva, Karma, Dharma etc. The establishment of the experimental truths of Vedanta in such a totally different society and culture demanded the back-breaking labours of a spiritual Hercules endowed with superhuman powers of the intellect and will. Four days after meeting Tesla, Swamiji wrote to his Madras disciple Alasinga:

Then you see, to put the Hindu ideas into English and then make out of dry philosophy and intricate mythology and queer startling psychology, a religion which shall be easy, simple popular, and at the same time meet the requirements of the highest minds - is a task only those can understand who have attempted it.'[6]

The main difficulty was the strait-jacket thinking of the scientists of those days who were almost totally reluctant to accept anything unless it came from their own stalwarts. In January 1896 Vivekananda openly exposed the scientific dogmatism of the West in his speech on *Microcosm* delivered in New York:

When a great ancient sage, a seer, or a prophet of old, who came face to face with the truth, says something, these modern men stand up and say, 'Oh, he was a fool!' But just use another name, 'Huxley says it or Tyndall', then it must be true, and they take it for granted. In place of ancient superstitions, in place of old Popes of religion they have installed modern Popes of science.[7]

The worship of scientific materialism was being safely conducted by the modern priests of science. Vivekananda's real

6. *Complete Works* (1973), vol.5, p. 104.
7. *Complete Works* (1976), vol.2, p. 218.

struggle was to make a dent in the adamantine walls of this great scientific bastion which 19th century Western thought had regarded as invincible and infallible.

But cracks began to appear in the same bastion, firstly as a sheer reaction to dollar-worshipping acquisitiveness and, secondly, as an effect of a series of revolutionary scientific discoveries from Michelson and Morley's experiment in 1893 to the latest findings of Particle Physics. And today the same Advaita Vedanta which the Oriental prophet gave them almost a century ago stands as the only solution to the enigmatic problems of modern physics. Within twelve years after Vivekananda's passing away came the first explosion from the First World War. After the First World War Europe's savant philosopher Romain Rolland, coming out of his imprisonment for anti-war propaganda, finally stumbled on the message of Ramakrishna-Vivekananda, and found it to be the only 'key to life', the only balm to a feverish Europe 'which had murdered sleep'. Even Rolland's upholding of Vivekananda's message failed to quieten the rising tumult of war and acquisitiveness - the two natural passions of a purely materialistic society. In 1939 came the much more devastating Second World War. In 1945 the first atom bomb was experimentally exploded at Alamogordo and then successfully dropped on Hiroshima and Nagasaki, to the shock and horror of millions of people. When the celebrated physicist and chief coordinator of the Manhattan Project, Robert Oppenheimer, went to attend a party hosted to celebrate the great occasion, he found, to his dismay, that the party was a 'dismal flop' and 'people later disagreed' about the bomb-explosion. In this state of confusion Oppenheimer saw an otherwise cool-headed scientist going out of the party to vomit. 'The reaction had begun' wrote a stupefied Oppenheimer.[8]

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8. Robert Oppenheimer, *Letters and Re-collections,* Edited by Alice Kimball Smith and Charles Weiner (Cambridge, Mass, Harvard University Press, 1980) p. 292.

On July 16, when the first bomb was experimentally exploded in the desert area of Alamogordo, and as the stupendous dazzling conflagration lit up the entire sky, Oppenheimer, standing ten thousand yards away, began to hum spontaneously the lines from the *Gita*:

If the radiance of a ten thousands suns
were to burst into the sky
that would perhaps be like
the splendour of the Mighty One.[9]

That was a moment of great significance when Western science converged towards Eastern Vedanta, as A. D. Reincourt says in his book, *The Eye of Shiva.*[10]

This convergence became more and more accentuated in subsequent years. Nobel physicist Schrodinger, writing on the growing importance of consciousness in Quantum Physics, declared:

In all the world there is no kind of framework within which we find consciousness in the plural. This is simply something we construct because of the temporal plurality of the individuals. But it is a false construction....The only solution to this conflict, in so far as any is available to us at all, lies in the ancient wisdom of the Upanisad.[11]

In his presidential address at the All-World Science Congress held in Washington in 1973 on the 500th anniversary of Copernicus, Nobel physicist Werner Heisenberg declared:

What is really needed is a change in fundamental concepts. We are probably forced in our concepts to abandon the atomic

9. *Srimad Bhagavad-Gita,* 11.12.
10. Amaury De Reincourt, *The Eye of Shiva* (New York: Willian Marrow & Company Inc., 1981) Pp. 13-14.
11. Erwin Schrodinger, *My View of the World* (London: Cambridge Univ. Press. 1964), Chapter 4.

materialism, of Democretus.... We cannot exclude the possibility that after some time the current themes of science and technology will be exhausted, and a younger generation will turn for rationalistic and pragmatic attitudes towards an entirely different approach.[12]

In his well-known book *Physics and Philosophy* Heisenberg anticipates 'an entirely different approach' to today's physics which is in keeping with the Eastern traditional philosophy.

The great scientific contribution in theoretical physics that has come from Japan since the last War may be an indication of a certain relationship between philosophical ideas in the tradition of the Far East and the philosophical substance of Quantum Theory.[13]

New writers on modern physics and Eastern thought in the late 70s of the twentieth century are turning more to Neo-Vedanta, the ancient philosophy of India as interpreted and adapted to modern thought by Sri Ramakrishna and Vivekananda. Amaury de Reincourt in his brilliant book on modern physics and Eastern philosophy entitled *The Eye of Shiva* stresses the paramount importance of the message of Indian mysticism.

... Can a connection between the scientific and mystical frames of reference be established over and beyond a certain metaphysical parallelism ? The answer lies in the fact that Indian mysticism, at least as far as its leading representatives are concerned, has evolved as much in the past hundred years as the science of physics itself, in a direction that points towards an inevitable convergence of the two.[14]

Reincourt points out what would perhaps be considered the most significant aspect of Vivekananda's interpretation of Vedanta.

12. *American Review*, Summer 1974, Pp. 48-55.

13. Werner Heisenberg, *Physics and Philosophy* (New York: Harper and Row Publishers, 1958) p. 173.

14. *The Eye of Shiva*

Reincount points out what would perhaps be considered the most significant aspect of Vivekananda's interpretation of Vedanta. With Swami Vivekananda Vedanta has in fact 'evolved' into a science which is interchangeable with the 'science of physics itself'. Religion is a matter of language, as Swamiji once pointed out to his British disciple Nivedita. It was Śaṁkara's mission to establish and resucitate Advaita Vedanta by ending the dominance of the Buddhist intellectuals and atheists of his time. And therefore Śaṁkara's way was primarily intellectual. His gigantic intellect dwarfed the philosophical adversaries of his time leading to the triumph of Advaita Vedanta all over India.

Vivekananda's mission was both Buddha's and Śaṁkara's. Both Buddha and Vivekananda were motivated by one pivotal reason - alleviation of human suffering. Vivekananda always reaffirmed that Buddha preached nothing but Vedanta in his simple ethical way which even Upali, the barber, or Chanda, the *caṇḍalā*, could grasp and practise. Vivekananda was absolutely clear about his mission. And this is how he expressed it to Nivedita:

> **My ideal indeed can be put into a few words and that is to preach unto mankind their divinity, and how to make it manifest in every movement of life.**[15]

The language and reason of modern science and physics that Vivekananda used for preaching Vedanta was just an instrument. His real mission was not merely the intellectual awakening, but also the spiritual elevation of mankind, especially in the materialistic West. The profound simplicity of his exposition sounds sometimes too simple to the ear of orthodox scholars. But it is the same ancient philosophy restated in modern language. A prophet is born primarily for the salvation of suffering

15. *Complete Works* (1972), vol. 7, p. 501.

humanity, not for teaching or entertaining scholars. And he does not rest until that philosophy becomes living, practical and dynamic in all spheres of life. Vivekananda came not just to preach a theoretical Vedanta, but also to demonstrate how to make it practical and solve the problems of life. Yet Vivekananda's intellectual brilliance in the new exposition of Advaita Vedanta is just phenomenal. He was preaching Vedanta like Ācārya Śaṁkara, but he was not preaching it to Hindu pandits or Buddhist scholars who where thoroughly soaked in the tradition of Sanskrit learning and the Upanisadic teaching. Vivekananda was speaking to the curious West neither acquainted with nor believing in the Upanisadic ideas which had till then remained hidden in cryptic books written in an archaic language, accessible only to a few scholars and specialists. His job was to bring Vedanta from the ivory tower of pandits to the doors of hard-core materialists and the laboratories of modern physicists, and finally to the arena of everyday living for common people. He wrote to his Madras disciple Alasinga:

The dry, abstract Advaita must become living - poetic - in everyday life: out of hopelessly intricate mythology must come concrete moral forms: and out of bewildering yogi-ism must come the most scientific and practical psychology - and all this must be put in a form so that a child may grasp it. That is my life's work.[16]

Vivekananda, whose approach combined both Buddha's passionate feeling for human suffering and Śaṁkara's brilliant exposition of the nature of the ultimate Reality, had a more humanistic and practical approach. In fact it was the mission of his life to make the mystical and intellectual Vedanta 'practical'. By 'practical' he meant attainable by all people in all walks of life. It is this Practical Vedanta that we find in Vivekananda's final summarization of Vedanta in five sentences:

16. *Complete Works* (1973), vol. 5, Pp. 104-105.

Each soul is potentially divine.

The goal is to manifest this Divinity within by controlling nature, external and internal.

Do this either by work, or worship, or psychic control, or philosophy - by one, or more, or all of these - and be free.

This is the whole of religion, Doctrines, or dogmas, or rituals, or books, or temples, or forms, are but secondary details.[17]

Now compare these lines with the aphoristic single-line statement of Śaṁkara of the essentials of Vedanta: **Brahman alone is real, the world is unreal; and the individual soul is nothing but Brahman,** Vivekananda takes the latter half of Śaṁkarācārya's line, and gives it supreme importance - the essential Divinity of life. Swamiji's five lines are an expression of this central theme of Vedanta which considers humanity to be 'heirs of immortal Bliss' (Amrtasya putrah). Of the first half of Śaṁkara's line, Swamiji emphasized the reality of Brahman more than the unreality of the world. He saw Brahman everywhere, in all people; he saw nothing else. The unreality of world was subsumed in the tangible, ever-present reality of brahman. The new profile given to the ancient Vedanta by Swami Vivekananda has come to be known as Neo-Vedanta.

There is yet another special feature in Vivekananda's interpretation of the ancient Vedanta Philosophy. Till then Vedanta philosophy had remained divided into three watertight systems: the Dvaita philosophy of the school of Madhva, the Viśiṭṣādvaita of Rāmānuja, and the Advaita philosophy of Śaṁkara. The exponents of each of these three streams of Vedanta philosophy always tried to eliminate the other two and to establish its own validity. Vivekananda, following the footsteps of his Master, Sri Ramakrishna, interpreted Vedanta philosophy for the first time in history in a comprehensive way which included all these three streams of thought. By Vedanta,

17. *Complete Works* (1977), vol. 1, p. 124.

Vivekananda always meant all the three schools of Vedanta: dualism, leading naturally by the process of reason to qualified monism, and qualified monism culminating in the same way in the Advaita. Dualism, qualified monism and non-dualism are only three gradually ascending stages of vision which unfold themselves as man develops finer and finer intelligence.

This was not only a historic achievement in the field of Indian philosophy but it was also the beginning of a far more comprehensive philosophy of life, for Vivekananda's interpretation of Vedanta negated nothing, either of heaven or earth. but made a bridge between the two. 'The old idea was', said Vivekananda, 'to develop one idea at the expense of all the rest. The modern way is 'harmonious development'!... He who gets the whole must have the parts too. Dualism is included in Advaitism (monism).'[18]

The 'modern way' of Vivekananda - Vedanta related ordinary life to spiritual sadhana, science to religion, action to contemplation, matter to mind, immanence to transcendence, the World to God, and man to Brahman, the supreme Reality. The far-reaching consequences of Vivekananda'a interpretation of Vedanta are yet to be fully understood and realized in the different levels of world culture today. Nivedita has expressed the profound uniqueness of Vivekananda's Vedanta in a few lines of unparalled clarity and depth:

It is this which adds its crowning significance to our Master's life, for here he becomes the meeting-point, not only of East and West, but also of past and future. If the many and the One be indeed the same Reality, then it is not all modes of worship alone, but equally all modes of work, all modes of struggle, all modes of creation, which are paths of realization. No distinction, henceforth, between sacred and secular. To labour is to pray. To conquer is to renounce. Life is itself religion.[19]

18. *Complete Works* (1972), vol. 7, p. 87.
19. *Complete Works* (1977), vol. 1, p. xv.

Like Buddha speaking in Pali to the commoner, or Christ speaking common Hebrew, Vivekananda was the first oriental prophet who preached Vedanta in the commonest language of the West - English. 'The Vedas, however, has to come down to our level', declared Vivekananda, 'for if they told us the highest truth in the highest way we could not understand it.'[20] And he was conscious that he was destined to speak of the Vedas not as a Hindu scripture, not as the cradle tenet of a particular religion called Hinduism, but as a statement of universal principles meant for all mankind. 'By the Vedas, no books are meant' he said, 'They mean the accumulated treasury of spiritual laws discovered by different persons in different time.'[21] And Vedanta is the quintessence or the central philosophy of the Vedas. What a stupendous task it must have been for him to speak of the highest Vedantic ideas of timeless heritage and universal appeal in the modern language of science, especially of physics and psychology, when physics itself was in an undeveloped stage during the period of Vivekananda's preaching in the West!

It is about Vivekananda's interpretation of Vedanta in the language of today's science that we will try to learn in the succeeding chapters.

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20. *Complete Works* (1972), vol. 7, p. 34.

21. *Complete Works* (1977), vol. 7, p. xiii.

3

THE QUEST FOR THE ULTIMATE BUILDING BLOCK OF THE UNIVERSE

THE word 'physics' is derived from the Greek *physis* meaning 'nature'; that is to say, physics is knowledge of the real nature of the physical universe. Its Sanskrit equivalent would be *ādhibhautika vidya*, objective knowledge, in contradiction to *adhyātmika vidya,* self-knowledge. In Indian thought a material 'thing' is regarded only as an object of knowledge. Knowledge is primary and the object is secondary. Kaṇāda, the father of Indian atomism, calls an object *padārtha*– the referent or 'meaning' (*artha*) of a word (*pada*).

The chief concern of Newtonian physics was the properties of matter. The basic question, 'What is the reality behind matter?' was thought to be too metaphysical or unnecessary to the nineteenth century physicists. But beginning from the end of the nineteenth century, fundamental questions regarding nature of matter began to be raised. The electron was discovered by J.J.Thomson in 1897 and the proton in 1919, by Rutherford. In 1900 Max Planck made the epoch-making discovery that heat is absorbed or emitted in definite quanta or packets. In 1905 Philip Lenard discovered the photoelectric effect, the emission of electron from a metal when light strikes it. Einstein combined

the ideas of Planck and Lenard and propounded the photon theory which applied the quantum concept to all forms of electromagnetic tradition.

In 1911 Rutherford first suggested the planetary model of the atom, with electrons orbiting around a nucleus consisting of protons (and also neutrons which were actually discovered by James Chadwick in 1938). The Danish physicist Niels Bohr in 1913 applied the quantum theory to atomic structure by regarding the electron's orbits or shells as representing definite levels of quantum energy. Finally Wolfgang Pauli, through this 'exclusion principle'; gave to every electron, a unique place in the orbit. The result was a neat-looking, clearly visualizable conceptual model of the atom. It looked as though modern physics had settled down to a clear-cut understanding of the ultimate building block of the universe, like that provided by the atomic models of Democretus and Dalton. The criterion for the validity of any new theory in physics is not only that the theory should give a correct picture or interpretation of the previous observations, but that it should also *predict* things which could be later confirmed by direct experiment. In this respect Bohr's theory of atomic structure was eminently successful.

Nevertheless, there were two points in Bohr's concept which made physicists uneasy. One was that the electrons orbiting along the shells against the pull of the central nucleus should, according to the known laws of electrodynamics, gradually lose their energy. But Bohr's theory did not admit this.

The second objection came from a different source. To account for the discrete nature of Bohr's orbits, the French physicist Louis de Broglie tried to draw an analogy between the set of discrete energy levels inside the atom and the discrete sets of mechanical

vibrations that are observed in the case of violin strings. In 1924 he formulated a simple equation which showed for the first time that not only waves behave as particles (as the 'photon' theory of Einstein showed) but particles also behave as waves. Broglies's equation determined the wave lengths for all the forms of matter like atoms, molecules, electrons, even baseballs and automobiles. The smaller the mass, the greater the wave length of a particle, and vice versa. That is why the wave lengths of baseballs or automobiles are not noticeable, while the wave length of the electron, which has got an incredibly small mass, is. Broglie's idea was verified experimentally in 1927 by two Americans, Clinton Davisson and Lester Germer. Davisson's experiment showed that when a beam of electron is sent through a very tiny opening, the beam of electron diffracts just as a beam of light does. And diffraction is a typical phenomenon of light behaving as a wave.

Broglie's discovery melted the hard particle, the electron revolving round its nucleus, into a fuzzy non-material wave thrumming around the nucleus. Scientists were at dismay. What is the electron then? How to resolve the contradictions in Bohr's picture of the atom? These questions acted as a great ferment, and atomic physics entered the most creative period in its history. There followed an intense effort to solve the riddle of the atom along two lines. Werner Heisenberg with the help of mathematics of matrices pictured electrons to be like chessmen moving on the chessboard, and argued that the existence of minimum portions of energy (quanta) prevents us from describing the motion of atomic particles in the conventional way by giving their successive positions and velocities, for the very attempt to determine either of these values with measuring instruments would disturb the motion of electrons. This is the celebrated

Uncertainty Principle which Heisenberg mathematically formulated in 1927.

The second line of enquiry was conducted by Erwin Schrodinger. He hypothesized in about 1925 that the waves of 'electrons' could also be quantized. And Schrodinger's wave-equation which won him Nobel prize in 1926, was in fact the big bridge between the contradictory views regarding sub-atomic phenomena; the particle nature (of light) and the wave nature (of electrons). Schrodinger's discovery was hailed as a great pace-maker. But the wave-particle duality of matter continued to trouble scientists. At this point came another German physicist Max Born who almost completed the abstract picture of the electron-wave. He hypothesized that electrons are not 'real' things. It is neither possible nor necessary to visualize these waves, as they are 'probability waves'. According to him the entire electron picture is 'a purely abstract.. mathematical concept...into which we cannot enter'.[1]

Yet the drive to unravel the mystery of the material electron and other sub-atomic particles continued. It led to two important consequences. One was the attempt to apply the Theory of Relativity to quantum phenomena, first attempted by Paul Dirac who formulated the field concept of electron. The other was the birth of another new branch of physics known as Particle physics. Scientists found that the mass of each electron varies with its velocity. They have hypothetically calculated the rest mass of an electron. As the electron speeds on, its mass increases from 100 times to as much as 11,800 times its rest mass, as happens in accelerators.

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1. Quoted by Gary Zukav in *The Dancing Wu Li Masters* (An overview of the New physics), (New York: Morrow Hill Paperbacks, 1979) p. 728.

Particle physicists have divided all sub-atomic particles, in order of their masses from the lightest to the heaviest, into three categories: Leptons or lightweight particles, Mesons or medium-weight particles and Baryons or heavy-weight particles. A few particles do not belong to this lepton-meson-baryon frame-work. Some of them are well known like photons, whereas the others have been theorized about but not discovered yet (like the gravitons). These are massless particles.

What is a massless particle? It has zero rest mass. When a photon is created it immediately moves with the speed of light. A massless particle is hypothetically possible, but, in reality, it is just an impossibility. No one has seen or felt the existence of a 'rest mass' since in the sub-atomic world, particles are always moving incredibly fast. The mass of the sub-atomic particles which the scientists find is always the relativistic mass. And this relativistic mass depends upon its velocity. For example, at 99% of the speed of light a particle has got a mass which is seven times larger than its rest mass. The rest mass is just a mathematical calculation. A photon which has all the mass due to motion has been arbitrarily described as a 'massless particle' in English language.

The mass of a sub-atomic particle is always presented in particle physics in terms of a unit of energy known as the electron volt. The rest mass of an electron is 0.51 million electron-volts. Or in other words, a proton has got nearly 2000 times the mass of an electron, 'Picture a massless particle' would say a particle physicist to his student. And the student will have no way but dive deep into a world of pure imagination.

But the search for the ultimate building block of the universe has continued until now when physicists have started facing the stark reality that this search might end up in a wild goose chase. And this is, in short, the history of the modern particle physics.

In the world of sub-atomic physics, physicists have come to conjecturing the existence of some 200 particles until today, and the number is obviously on the increase. Most of these particles have got an incredibly short life and size. A positive electron lasts only 10^{-8} second. A neutral pi-mesons (called 'pion') lasts no longer than 10^{-14} second.[2] In the period between the two World Wars physicists had invented two names for designating the atoms of time and space. The atom of time is termed 'Chronon which is of the order of 10^{-21} second according to J.H. Thomson 'Hodon', the atom for space has a radius of 10^{-23} cm. In the latest experiments of high-energy particle physics physicists have met with particles which live only a few particle-second (a particle-second is 10^{-23} second or 0.00000 00000 00000 00000 00001 second). And then they change into other particles. The most short-lived particle has been termed 'Resonance'. A Resonance is a particle, but not an object. It is better described as an event, an occurrence, or a happening, says Prof. Capra. New particles are created only when known particles collide with an unimaginably high velocity, sometimes nearing that of light Every sub-atomic interaction consists of the annihilation of the original particles and the creation of new sub-atomic particles as is shown clearly in the famous Feynmann's diagrams. This energy dance, this endless process of destruction-creation of sub atomic particles, is going on at this outer space. Professor Fritjo Capra has ingeniously and logically compared this eternal and cosmic dance in the outer space of our earth to the mystic dance of the great God Natarāja Śiva. Śiva, the protector of Umā (which means our earth) is saving her and all the creatures (Śiva is the father of all creation - Bhūtanātha) with his four hands.

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2. Milic Capek, *The Philosophical Impact of Contemporary Physics* (Princeton, New Jersey: D. Van Nostrand Co. Inc, 1961) p.259)

3. Fritjof Capra, *The Tao of Physics,* (Berkeley: Shambhala, 1973) p. 244

The right upper hand holds a drum to symbolize the primary sound of creation in the universe.

The left upper hand bears a tongue of flame symbolizing the destruction of harmful cosmic particle from outer space.

The right lower hand is raised in the sign of - 'Do not be afraid. I am protecting you all.'

The left lower hand points down to the 'uplifted foot' which symbolizes surrender at the feet of Siva - the protector.[4]

But the question about the ultimate building block remains unanswered. What is it that collides? Energy or mass? What is the mass composed of? What is the smallest particle composed of? Particle physics and quantum physics have no answer. Says Heisenberg, **'In the light of the quantum theory.... elementary particles are no longer real in the sense as objects of daily life, trees or stones.'**[5]

Today physicists are divided into two schools. One school, still seeking a material substratum of the universe, is directing its search towards a hypothetical object called 'quark'. 'Quark' is a term which scientists have taken from James Joyce's book *Finnegans Wake* where Joyce says, 'Three Quarks for Muster Mark'. It was first used for these particles by the American physicist Murray Gellmann. This school of physicists believes that all the known particles are composed of a few different types of particles called quarks. But no one has found a quark yet. These strange 'particles' (all hypothetical) are supposed to have $^1/_3$ unit of electrical charge. Until now no particle is found to have a charge other than a whole unit. The search for quarks is still continuing. But many scientists today believe that it may end in the paradox: which is earlier, the egg or the hen? Or

4. *The Tao of Physics,* p. 244.
5. Quoted in *The Dancing Wu Li Masters. p.216*

in other words, there will remain the unanswered question - What are these quarks made of? 'Not only can a micro physical particle not be observed twice, as Schrodinger asserted, but not even once, as the consistent application of Heisenberg's uncertainty principle asserts.'[6]

The other school of physicists who have abandoned this way of finding the 'ultimate building block of the universe' in what Kenneth Ford called the 'Particle Zoo', is following the S. Matrix theory or the Scattering-Matrix theory originally proposed by Heisenberg. This has now been developed into another theory called the bootstrap theory of which the most powerful exponent is Geoffrey Chew, chairman of the physics department, Berkeley. Both these new theories have finally abandoned the ultimate-particle search. Their adherents are trying to show, and have to a large extent succeeded in doing so, that in the subatomic world no particle is an independent entity. In fact these are nothing but 'events' interconnected with others. In the words of Fritjof Capra, a sub-atomic particle is an entity, but is neither a particle nor an object. It is just a 'dynamic pattern of interconnected energy'. 'Events and not particles constitute the objective reality' was the conclusion of Sir James Jeans.[7] The bootstrap theory, by its very name, suggests that one end of the bootstrap is inextricably connected with the other end, however intricate and complicated the connection may be.

Geoffrey Chew's bootstrap theory is slowly gaining acceptance among a larger number of physicists today. One of the factors that is being slowly felt as an indispensable necessity in this theory is the inclusion of consciousness in determining external

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6. Quoted in *The Philosophical Impact of Contemporary Physics,* p. 389

7. Quoted in *The Philosophical Impact of Contemporary Physics,* p. 391.

reality. Physicist Fritjot Capra in his latest book *The Turning Point* upholds the consciousness factor in the bootstrap theory: **'Increased use of the bootstrap approach opens up the unprecedented possibility of being forced to include the study of human consciousness explicitly in the future theories of matter.....Some physicist argue that consciousness may be an essential aspect of the universe, and that we may be blocked from further understanding of natural phenomena if we insist on excluding it.'**[8]

Arthur Koestler coined a word, 'holon', to describe the sub-atomic particle, since each of them is inextricably connected with the rest of the Universe. Each particle reflects the 'whole', as it were.[9] Physicist David Bohm has used this concept of holon in his new theory of matter which he calls - an 'Implicate order'. The movement of a single particle, according to this theory, is connected with the movement of the entire universe. Therefore it is not the movement of the individual particle but 'holo-movement'. To establish his theory, says Fritjof Capra, Bohm has found it necessary to regard consciousness as an essential feature of the holo-movement and to take it into account explicitly in his theory.[10]

Physicist John Wheeler speaks of the entire material universe as a 'Quantum foam' in which every particle is linked with every other particle in what he terms 'quantum interconnectedness'. Wheeler also offers the idea of 'Super-Space' in which everything is interconnected in a deeper way. As early as 1876 W. K. Clifford theorized that matter is nothing more than empty, curved space. Wheeler has developed this idea further and writes. 'There

8. Fritjof Capra, *The Turning Point*, (New York: Simon and Schuster, 1982), p. 95
9. *The Turning Point*, p. 43
10. *The Turning Point*, p. 96

is nothing in the world but empty curved space. Matter, charge, electromagnetism and other fields are only manifestations of the bending of space. *Physics is Geometry*'[11] For Einstein empty space is a participant in the cosmic drama, its geometry having effect on events. For Wheeler, 'the vacuum is a froth of particles and fields. 'Space', says Wheeler, 'is foam like'.[12] Wheeler goes further and explains his concept of 'quantum foam' - 'The space of quantum geometro-dynamics can be compared to a carpet of foam spread over a slowly undulating landscape.... The continual microscopic changes in the carpet of foam as new bubbles appear and old ones disappear symbolize the quantum fluctuations in geometry.'[13]

We are reading just a translation into a language of modern physics what the millennium-old Vedantic text *Drg-Dṛśya-Viveka* has mentioned. 'The manifestation of all names and forms in the entity called Brahman, which is Existence Consciousness-Bliss, like the foams etc. in the ocean, is known as creation.'[14] At the Parliament of Religions held in Chicago in 1893, Swami Vivekananda expressed the same idea and related it with monistic Vedanta:

Science has proved to me that physical individuality is a delusion, that really my body is one little continuously changing body in an unbroken ocean of matter, and Advaita (unity) is the necessary conclusion with my other counterpart, soul.[15]

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11. Quoted by Michael Talbot in *Mysticism and the New Physics.* (New York: Bantam edition), p. 77.
12. *The New York Times Magazine,* 26 September 1982, p. 69.
13. Quoted in *Mysticism and the New Physics,* p. 77.
14. Drg-Dṛśya-Viveka, verse 14.
15. *The Complete Works of Swami Vivekananda* (Calcutta: Advaita Ashrama, 1977) vol. 1, p. 14.

Thousands of years ago the Upanisads realized this fundamental truth - the entire universe is one, interconnected and interpenetrated by the ultimate reality which they termed Brahman. 'That Reality, O Gārgī, has interpenetrated the whole universe', says the sage Yajnavalkya.[16] And the ultimate nature of Brahman is eternal (and therefore all-pervading) existence, eternal (and therefore all penetrating) knowledge, eternal (and therefore interprenetrating the entire universe including the mind of man and his consciousness) bliss. The *Muṇḍaka Upaniṣad* begins with the question of a student to his guru: '(What is it.) O adorable sir, which having been known, all this becomes known?' After a lengthy discourse the teacher concludes: 'Know that One Ātman which has interpenetrated the earth, the subtler world of thought, the cosmic heavens, the mind and the vital energies of all living beings. Give up all other vain talks. That is the way to Immortality.'[17] The interrogation of *kasmin* (by what) is answered by the emphatic assertion of *yasmin* (by that) which is Brahman.

Modern particle physics shows the folly of trying to search for a single object, a sub-atomic particle or an electron as a separate independent reality. Such a thing does not exist. The very experience of the independent existence of one thing is unreal. Vedantin terms it *mithyā* The right vision is to perceive the whole in the socalled isolated entity. This is what the Vedantist means by the statement 'Brahman alone is real.' The adherents of Logical Positivism and scientific materialism in the West, who tried to cling obstinately to a material universe, were dismayed at the withering of a material universe. Here is how Bertrand Russell describes his own experience: '**As regards metaphysics... I experienced the delight of believing that the**

16. *Brhadaranyaka Upanisad.* 3.8.8.
17. *Mundaka Upanisad.* 2.2.5.

sensible world is real. Bit by bit, chiefly under the influence of physics, this faith has faded... I find myself in a vast mist of solitude both emotional and metaphysical from which I can find no issue.'[18]

Vedantic epistemology and ontology transcended this sense bound universe millenniums ago. Physically, mentally and spiritually reality is **whole**. Each atom, says Vivekananda, reflects the whole universe. The biggest is reflected in the smallest - says the *Katha Upaniṣad - Aṇoraṇīyān mahatomahīyān'*. And Vivekananda puts this Vedantic vision in a very realistic and pragmatic way which shows that the solution of local problems in this world must always be sought in a global way. This is where Vivekananda brings the findings of modern physics to have a direct bearing on the socio-cultural life of this world. Says Swami Vivekananda:

> **'One atom in this universe cannot move without dragging the whole world along with it. There cannot be any progress without the whole world following in the wake, and it is becoming everyday clearer that the solution of any problem can never the attained on racial, or national, or narrow ground. Every idea has to become broad till it covers the whole of this world, every aspiration must go on increasing till it has engulfed the whole of humanity, nay the whole of life within its scope.'[19]**

The Theory of Relativity has proved the relative nature of all matter. Quantum physics has shown that matter has no purely objective reality. Particle physics has shown that the concept of a separate, individual, isolated piece of matter does not exist. What we see as isolated matter is deeply and intrinsically

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18. Quoted by Amaury De Reincourt in *The Eye of Shiva,* (New York: William Morrow & Company Inc., 1981) p. 172.

19. *The Complete Works of Swami Vivekananda* (Calcutta: Advaita Ashrama, 1973) vol. 3, p. 269

interconnected with the whole universe. David Bohm, the London physicist experimenting on Bell's Theorem (to be discussed in a later chapter), claims that the whole universe of space-time is connected at a deeper and fundamental level. Twentieth-century physics has already stepped into the domain of metaphysics. Swami Vivekananda pointed out this culmination of Western physics in Vedanta as early as 1895 when the new physics of this century had not even been dreamt of. At the Thousands Island Park in New York State he said:

Modern science has really made the foundations of religion strong. That the whole universe is one is scientifically demonstrable. What the metaphysicians call 'being', the physicist call 'matter', but there is no real fight between the two, for both are one.[20]

That physics is connected with metaphysics, that all matter is connected with mind, is one of the basic Vedantic truths. Vivekananda expresses it almost in the language of today's physics:

Physics is bounded on both sides by metaphysics. So it is with reason - it starts from non-reason and ends with non-reason. If we push inquiry far enough in the world of perception, we must reach a plane beyond perception. Reason is really stored up and classified perception, preserved by memory. We can never imagine or reason beyond our perceptions.....[21]

In these prophetic passages Vivekananda anticipated the holistic and mystical approach that modern physics has been compelled to accept today. Nearly a century after Vivekananda, we hear the bold confirmation of his ideas in the words of physicist Fritjof Capra:

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20. *The Complete Works of Swami Vivekananda* (Calcutta: Advaita Ashrama, 1972) vol. 7, p. 50

21. *The Complete Works of Swami Vivekananda* (Calcutta: Advaita Ashrama, 1977) vol.8, p. 20-21.

'Scientists will not need to be reluctant to adopt a holistic framework, as they are often today, for fear of being unscientific. Modern physics will have shown them that such a framework would be not only scientific; it would be consistent with the most advanced scientific theories of physical reality.'[22]

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22. *The Schumacher Lectures*, Ed. by Satish Kumar, (London: Abacus Edn., Sphere Books Ltd., 1982) p. 135

4

THE UNCERTAINTY PRINCIPLE AND THE OMNIJECTIVE REALITY

IN 1926 the picture of the subatomic world of electrons was one of 'Standing Waves' of Schrodinger and 'Probability Waves' of Max Born. The hard reality of electron had already melted to wave-particle duality. In 1927 Werner Heisenberg, in an epoch making discovery, finally showed that not only the electron picture is a blurred one, but that the electron itself is not knowable through any possible scientific experiment. This discovery was epoch-making in the sense that it shook the very foundations of the 'exact sciences' which since the time of Laplace (1749-1827) claimed that things do and must happen in a 'deterministic' and 'certain' way according to the law of cause and effect (often called Laplacean determinism). Classical or Newtonian physics holds that the universe is like a perfect clock. Once we know the position of its parts at one instant, they would be for ever specified. This deterministic view was expressed by Laplace in an oft-quoted passage :

We ought then to regard the present state of the universe as the effect of its antecedent state and the cause of the state that is to follow. An intelligence knowing at any given instant of time all forces acting in nature, as well as the momentry positions of all things of which the universe consists, would be able to comprehend the motions of the largest bodies of the world and those of the smallest atmos in one single formula, provided it were sufficiently powerful to subject all data to analysis : to it *nothing would be uncertain,* both future and past would be present before its eyes.

Heisenberg showed that subatomic entities like the electron can never be measured or determined in a 'causal way' There is and must always be an element of 'uncertainty' or 'indeterminacy' in our knowledge of the electrons. This discovery is known as the Uncertainty Principle or the Principle of Indeterminacy. It postulates that if we try to determine precisely the momentum or the velocity of the electron, we will know almost nothing about its position and vice versa. Einstein's Theory of Relativity had shown that in order to know a thing in its true nature we must know the mass (space-dimension) and the velocity (time-dimension) of the thing. In the subatomic world where the so-called electron and other particles move at an incredibly high speed, sometime nearly the velocity of light, it is essential that we must know the velocity of the particle. Since with the increase in velocities the mass of these particles also increases, knowledge of the velocity of the electron is a must. In short, to know an electron we must know (a) where it is and (b) what its velocity is. And here comes the eternal and the unsurmountable block in the progress of quantum physics. These two things can never be known together. If one is known fully the other is bound to remain totally unknown.

In order to illustrate this principle, Heisenberg made his celebrated 'Gedanken experiment' or 'thought experiment'. Heisenberg imagined a super microscope of extraordinarily high power, powerful enough to see the electron moving round the nucleus. When we seek the shadow of a thin hair on the wall by means of ordinary light we see no shadow, because the hair is so thin that it cannot obstruct the light waves of ordinary light. In other words, to see something we have to use a light whose wavelength is smaller than the thing. Heisenberg thought of gamma rays to spot out this elusive electron, because gamma rays have got the shortest wave length and this is just what he needed to see an electron which is extraordinarily small. But

unfortunately the gamma ray which has the shortest wavelength has also got much more energy than ordinary light. Einstein had already shown in his study of photo-electric effect that electrons are knocked out whenever ultraviolet rays meet them. And the ultraviolet ray is comparatively much less powerful than the gamma ray. So when the super-powerful gamma ray from Heisenberg's super-microscope is focused on the fast-moving electron in its orbits, it illumines the electron no doubt, but at the same time it violently knocks the electron out of its orbit and changes its direction and speed (its momentum). And this change in direction and momentum occurs in an uncontrollable and unpredictable way. Heisenberg put the whole imaginary hunt for the electron with gamma rays in the following equation :

$$\Delta Q \times \Delta P \geq h$$

where Q is the uncertainty about the velocity of the electron, P is the uncertainty about its position and *h* is Plank's constant which is a definite number (6.63×10^{-27} erg. sec.). The equation simply says that when Q, the uncertainty about the velocity, is zero (that is to say, when we know the velocity with perfect precision) then P, the uncertainty in our knowledge about the position of the electron, must be infinite, because the multiplication of ΔP by ΔQ must be greater than or equal to *h*. Had *h* been equal to zero (which it is not) then we could simultaneously have both the uncertainty about position (ΔP) and the uncertainty about velocity (ΔQ) also as zero. That means we could know both the velocity and the position of the electron with perfect precision. But since *h* is a fixed quantity, either of the uncertainties must always remain.

Heisenberg's equation, it must be remembered, is not meant for a single electron but is a statistical average of lots of measurements regarding the position and momentum of a vast number of electrons taken together. The individual electron is a 'blur', a 'misnomer', a non-entity. When a vast crowd of people

bifurcates along two roads, an observer standing high up on a distant building can only say that 60% of the vast crowd has gone by one road and the rest by the other road. The observer can never say from such a distance which particular individual went by which road. The world of electrons is somewhat like that. In fact the real nature of the electron is enshrouded in mystery to such an extent that scientists today have been forced to conceive the idea of an 'electron cloud' which is made of various electron waves round the nucleus. 'Electron cloud' is a purely mathematical concept which scientists use to express in language what they find in experiment. In other words, concepts in quantum theory are not exact descriptions of what happens in the quantum world of electrons, but represent a hypothetical language to express what they have found experimentally. Niels Bohr's remark on this aspect of quantum physics is unforgettable : **'It is wrong to think that the task of physics is to find out how Nature is. Physics concerns what we can say about Nature.'**[1]

Two aspects of Heisenberg's uncertainty principle at once demolished the two old pillars of classical physics : (1) causality and (2) the objective description of reality. The first one says that the Newtonian laws of cause and effect do not apply in the quantum world of subatomic particles (or waves). The second one says, we cannot observe anything without changing it. A purely objective description of the subatomic world is impossible. As physicist John A. Wheeler has said, the detached observer-scientist of classical physics is no mere a detached observer looking through a microscope at something separate from himself. But he is also the participator in the quantum drama. He is both the 'actor' and 'participator' as physicist James Jeans puts it,

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1. Heinz R. Pagels, *The Cosmic Code,* Quantum Physics as the Language of Nature, (New York : Bantam New Age Bantam Edition, 1983). p.67.

in the great drama of existence. Reality in the quantum world is no more purely objective but is connected with the 'subjective' element of the physicist. To describe this phenomenon Michael Talbot in his recent book *Mysticism and New Physics* uses the word **'omnijective'**. Realities like electron in the subatomic world have always an **'omnijective'** existence for the physicist, that is, the objective reality is inextricably connected with the subjective consciousness of the scientist.

Naturally with Heisenberg's uncertainty principle the entire world of physics was thrown into a state of convulsion. The discovery was certainly unexpected and iconoclastic. Praise and ridicule equally poured on Heisenberg. And the whole flock of quantum physicists including Einstein, Wolfgang Pauli, Max Born, Niels Bohr and Schrodinger gathered in Germany at what is known as the Salvay Congress to discuss the probable consequences of the new quantum physics. The whole congress was dominated by Niels Bohr who by his concept of complementarity gave a new interpretation of quantum phenomena which was acceptable to most of the scientists except Einstein who refused to accept the uncertainty principle *as final*. Since the ideas of Bohr and Heisenberg were developed at the Physical Institute in Copenhagen, the native place of Bohr, the new interpretation has come to be popularly known as the Copenhagen Interpretation of Quantum Physics.

Physicists after 1927 had no way but to think in a totally revolutionary manner about the subatomic world. They had to abandon their accustomed ports and set sail in an unknown sea in search of the reality of the subatomic world. The old materialistic concept of a separate and independently existing external reality ceased to have any meaning for the new scientists. Scientific materialism and its ardent votaries listened with awe to this high priest of New Physics, Heisenberg, who declared: 'It may be easier to adapt oneself to the quantum theoretical

concepts of reality when one has not gone through the naive materialistic way of thinking that still prevailed in Europe in the first decades of the century.[2] Heisenberg openly asserted that the new findings of quantum physics were incompatible with the philosophy of dialectic materialism. He wrote : 'We cannot possibly expect those thinkers who a century ago introduced dialectic materialism to have forcseen the development of quantum theory. Their concepts of matter and reality could not be possibly adapted to the results of the refined experimental technique of our days'.[3]

But materialism dies hard. Heisenberg was doubted and distrusted by several well-known physicists of those days. They said 'The poetic nature of your spirit led you to unlimited sphere of theories where a poetic nature is the most dangerous comparison of all.' His theory was dismissed as 'atomystics' and speculation until subsequent experiments proved it to be correct.[4] 'The Copenhagen interpretation led scientists.' writes Heisenberg's biographer, A. Hermann, 'far beyond the frontiers of physics'.[5] But intellectual opposition continued until it turned out to be a semi-political antagonism. Two German physicists Lenard and Stark backed by the nationalist government opposed Heisenberg's appointment to the chair of physics from which his teacher Sommerfeld had just retired. They even propounded a new physics known as 'German Physics' which was only the 19th century physics extended by some new data. And this they propounded against Heisenberg's quantum theory. But all opposition finally ended in acceptance. Heisenberg wrote. **'A new scientific truth does not usually make its way because its**

2. Werner Heisenberg, *Physics and Philosophy* (New York : Harper and Row Publishers, 1962) p.202.
3. *Physics and Philosophy,* p.139.
4. Armin Hermann, *Heisenberg* (Reinbeknear Hamburg : Rowohlt Taschenbuch Verlag gmbH, 1976). Pp.121-22.
5. *Heisenberg,* p.40

opponents are convinced and proclaim their conversion but rather because these opponents gradually die out and the up-and-coming generation is acquainted with the truth from the start'.[6] Quantum physics standing against a materialist world view started its voyage to further regions of human intuition.

Primacy of Consciousness over Matter

However successful Heisenberg was in establishing his uncertainty principle - that the act of observation by the scientist alters the condition of the quantum particles observed - Einstein refused to accept it. In 1933 Einstein propounded that there must be a 'hidden variable' somewhere which is responsible for this uncertainty. As a rule, Einstein believed, there cannot be any indeterminacy in the world of physics. However, until the time of Einstein's death, no such 'hidden variable' nullifying Heisenberg's uncertainty principle was found. In 1961 Nobel physicist Wigner proposed that it is the **'consciousness of the scientist which is itself the hidden variable'**[7] that decides which outcome of an event actually occurs. The question of measurement arises only when human observation intervenes. Wigner asserts that it is impossible to give a description of quantum mechanical processes **'without explicit reference to consciousness'.**[8]

Wigner's assertion that the consciousness of the scientist is directly responsible for the ultimate knowledge of the external reality brings modern physics almost at the door of Vedanta. Vivekananda clarifies the Vedantic idea of the act of observation and the inextricable connection between the observer and the observed.

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6. Biophysicist Lyall Watson writes humourously about this new truth of Quantum Physics : 'Experiments about electrons boil down in the end to experiments in professors.' See, his *Lifetide* (New York : Bantam Books Inc. 1979). p.314.
7. Michael Talbot, *Mysticism and the New Physics* (New York : Bantam books, 1981) p.33.
8. *Mysticism and the New Physics,* p.34.

'...The Vedanta also shows that what is called intelligence is a compound. For instance, let us examine our perceptions. I see a blackboard. How does the knowledge come ? What the German philosophers call 'the thing-in-itself' of the backboard is unknown, I can never know it. Let us call it x. The blackboard x acts on my mind, and the mind reacts. The mind is like a lake. Throw a stone in a lake and a reactionary wave comes towards the stone; this wave is not like the stone at all, it is a wave. The blackboard x is like a stone which strikes the mind and the mind throws up a wave toward it, and this wave is what we call the blackboard. I see you. You as reality are unknown and unknowable. You are x and you act upon my mind, and the mind throws a wave in the direction from which the impact comes, and that wave is what I call Mr. or Mrs. so-and-so. There are two elements in the perception, one coming from outside and the other from inside, and the combination of these two, x + mind, is our external universe. All knowledge is by reaction. In the case of a whale it has been determined by calculation how long after its tail is struck, its mind reacts and the whale feels the pain. Similar is the case with internal perception. The real self within me is also unknown and unknowable. Let us call it y. When I know myself as so-and-so, it is y + the mind. That y strikes a blow on the mind. So our whole world is x + mind (external), and y + mind (internal), x and y standing for the thing-in-itself behind the external and the internal worlds respectively.[9]

Physicist John A Wheeler believes that the term 'observer' should be replaced by the term 'participator'. This replacement, he believes, will give a radically new role to consciousness in physics. Instead of denying the existence of the objective reality he further asserts that the subjective and the objective sort create each other. They are "self-existing systems" and brought into being by "self-reference."[10]

On January 25, 1931, *Observer* published an *'Interview with Max Plank'* by J.W.N. Sullivan. In answer to the question, 'Do

9. *The Complete Works of Swami Vivekananda*, (Calcutta : Advaita Ashrama, 1976). vol.2, pp.457-58.
10. *Mysticismand the New Physics*, p.35.

you think that consciousness can be explained in terms of matter and its law?' Max Plank answered that he did not. 'Consciousness', Max Plank continued, 'I regard as fundamental. I regard matter as derivative from consciousness. We cannot get behind consciousness. Everything that we talk about, everything that we regard as existing postulates consciousness.'[11]

Wolfgang Pauli, the Nobel physicist famous for his Exclusion Principle, writes in words which are, in fact, interchangeable with the words of Vivekananda.

'From an inner centre the psyche seems to move outward, in the sense of an extraversion, into the physical world...'[12]

Wigner's and Max Plank's idea of the importance of consciousness, Talbot's concept of 'omnijective reality', Wheeler's concept of subject and object as 'self-existing systems', Pauli's idea of the outgoing of the psyche towards external creation - all these bring us to the core of New Physics, which after these discoveries stand totally against the *scientific materialism* of classical physics of Descartes, Laplace and Newton which was based on a strict division between mind and matter.

Swami Vivekananda was never tired of asserting the oneness of mind and matter in his exposition of Vedanta. 'Mind becomes matter and matter in its turn becomes mind, it is simply a question of vibration.'[13] Nobel physicist Erwin Schrodinger in his celebrated books *My View of the World* and *Mind and Matter* establishes the fact that the dualism of mind and matter can never be resolved

11. James Jeans, *Philosophical Aspects of Modern Science* (London : George Allen and Unwin, 1932), p.12.

12. W. Pauli and C.G. Jung *The Interpretations of Nature and the Psyche* (Princeton, N.J.: Princeton University Press 1955) p.175 quoted in Gary Zukav, *The Dancing Wu Li Masters* (An Overview of the New Physics) (New York : Morrow Hill Paperbacks, 1979) p.56.

13. *Complete Works,* (1978) Vol.6. p.34.

on the material plane but only on the psychic plane, which according to him is the only eternally existing substratum of the Universe. Schrodinger echoes Max Plank and drives home directly the Vedantic principle that Consciousness creates matter and not vice versa.

'Attempt to resolve the dualism of mind and matter was also attempted in the West in past, but the attempt was carried always on the material plane and therefore, it failed.' Schrodinger offers his comments on this attempt... 'It is odd that it has usually been done on material basis...But this is no good. If we decide to have only one sphere, it has to be the psychic one, since that exists anyway.'[14]

The New Columbuses move towards a New Continent of 'Atomysticism'

In the deep forest of Walden, forty miles away from a main city of America, was living alone a saintly man spending his time in meditation and reading books like the Gita and the Upanisads. He was Henry David Thoreau, an outstanding name in the intellectual and social circles of American life in the midnineteenth century. In order to see this *rishi*-like life of Thoreau, his friend Emerson came one day, walking like his friend all the way up the forest path. After a few cordial words Emerson put to him, what he thought, one pertinent question. 'How do you live here without newspaper?' The *rishi* lifted up his eyes and wondered - 'Where is the news? During the last two thousand years there have been only three items - Crucifixion of Christ, Columbus' discovery of America and the French Revolution. Others are variations on old themes.' Had Thoreau been living today he would have included Quantum physics as the fourth important news of history.

14. Erwin Schrodinger *My View of the World* (London : Cambridge University Press, 1964) pp.62-63.

One late afternoon, in the early summer of 1922, two physicists were walking along the slopes of Hein mountain in Germany. The elder one, Niels Bohr, was already a veteran physicist; the other was a young university student of twenty. The younger one was putting strange questions to the elder leader. Heisenberg, probably born with some powers of 'seeing' things beyond sensory level, was bombarding Bohr's support of the planetary model of the atom which was offered in 1913 by Ernest Rutherford. On this model Bohr was trying to erect his theory of Hydrogen spectrum. The young physicist's queries began to shake the foundations of Bohr's dream, and Bohr agreed finally that atoms are not real 'things'. In describing the atomic phenomena, Bohr agreed that physicists had already moved far far away from the Newtonian Physics describing an atom like the movement of the car or the path of a projectile. It was already clear to both of them, even in the early twenties that 'there can be no descriptive account of the structure of atom,' for all such accounts must necessarily be based on classical concepts which, as they saw, no longer held good. Startled at the strange outcome of the long talk, **Heisenberg suddenly put the question to Bohr, 'If the inner structure of an atom is as closed to descriptive accounts, as you say, if we really lack a language for dealing with it, how can we ever hope to understand atoms?' Bohr hesitated for a moment and then said, 'I think we may yet be able to do so. But in the process we may have to learn what the word "understanding" really means'.**[15] That was a very profound utterance. There was an imperative need for all quantum physicists to switch over to a new kind of understanding, which would distinctly differ from sensory-perception understanding of this gross world as Newton understood it. Heisenberg intuitively felt that 'this walk was to have profound repercussions

15. Werner Heisenberg *Physics and Beyond* (New York : Harper and Row Publishers, 1971) p.41.

on my scientific career, or perhaps it is more correct to say my real scientific career only began that afternoon'.[16] The 'New Understanding' had not yet revealed its true nature. But it was heading for a holistic perception of an all-pervading unity which is the theme of Vedanta.

That was the evening when Heisenberg felt that, in order to explore the undiscovered continent of the atomic world, he and his colleagues would have to sail on uncharted seas like Columbus. Heisenberg wrote, 'If I were asked what was Christopher Columbus' greatest achievement discovering America, my answer would not be that he took advantage of the spherical shape of the earth to get to India by Western route. ...His most remarkable feat...was the decision to leave the known regions of the world and to sail westward, far beyond the point from which his provisions could have got him back home again.[17]

Einstein, in his Relativity Theory had already made a final departure from the old moorings of Newtonian Physics, which had so long asserted that 'time and space are real independent realities'. Yet Einstein's strings were being pulled back by one anti-current : it was his unwillingness to accept what Heisenberg urged, **'We must get away from the idea of objective process in time and space'.** Heisenberg mustered the courage of a desperate sailor and started sailing to the unknown all alone. But this time his ship of knowledge was sailing not towards the West, but towards the East, where people had known thousands of years before that the true nature of Reality could only be known by the intuitive power of a purified mind. The only pole-star for Heisenberg's ship in this voyage in the non-objective world of atoms became what he called Sommerfeld's **'atomysticism'.**[18] Heisenberg realized that Physics had already

16. *Physics and Beyond,* p.381.

17. *Physics and Beyond,* p.70.

rejected the hard, material reality of the atom and entered into the field of mystical perceptions. But what could be the polestar in this journey of the New Columbus? Heisenberg felt lonely and even felt rejected at times by his own leaders and colleagues. "You are moving on very thin ice," Einstein warned me, "for you are suddenly speaking of what nature really does. In science we ought to be concerned solely with what nature does."[19] But despite warnings, Einstein (probably without his knowing it) in fact led Heisenberg to the right path. During those days of heated discussions with Bohr, Einstein, Pauli and Schrodinger, came the moment of revelation in the life of Heisenberg, 'One evening, after midnight when I suddenly remembered my conversation with Einstein and particularly his statement: "It is the theory which decides what we can observe" I was immediately convinced that the key to the gate that had been closed for so long must be sought here, right here.'[20] Heisenberg intuitively stumbled on a basic postulate of Vedanta - that the subjective shapes and decides the nature of the objective. And following his line a large number of Quantum Physicists are increasingly ceasing to be only experimentalists and materialists and are turning into what Sommerfeld called 'atomystics'.

Einstein's view that 'it is the theory which decides what should be nature of the experiments' reminds us of what Vivekananda told Western people in 1890s. 'We first perceive, then reason, later. We must have this perception as a fact and it is called religion, realisation.[21] This 'Atomysticism' was the beginning of Heisenberg's intuitive exploration of the atomic world which ended in his epoch-making discovery of the 'uncertainty principle'. Einstein also told him categorically that physics no more believes

18. *Physics and Beyond,* p.72.
19. *Physics and Beyond,* p.68.
20. *Physics and Beyond,* p.77.
21. *Complete Works* (1972) Vol.7 p.75.

in *'experiment-observation-inference-method'*. 'It is nonsense all the same' Einstein continued: **'It is the theory which decides what should be the nature of the experiment'.**[22]

The indeterminism of the wonderland of Alice

The idea of indeterminism - that the sure cause-and-effect relation does not apply to the quantum or subatomic world - had an equally startling effect on the world of science. Einstein, the staunch vanguard of strict determinism, was insisting on proving that classical causality must ultimately prove true even in the quantum world. In 1935 Einstein, along with two of his associates Podolsky and Rosen, formulated a mathematical paradox known as EPR paradox. Through this formulation Einstein tried to prove the falsity of quantum indeterminism, but, quite contrary to all his expectations, this EPR effect ultimately resulted in the formulation of another epoch-making discovery of modern science, namely, Bell's Theorem, which supported both theoretically and experimentally, that the local causality (that there must be a sure effect for a cause in a certain limited area) is a limited, and in fact, a false concept. A hand grenade thrown in a Calcutta street may break the glasses of a few Calcutta windows. This is common knowledge. But, nobody believes that the same hand grenade may also break window glasses in a California street. And this is exactly what Bell's theorem suggests. This we will discuss in detail in the section on Bell's theorem.

Vedanta describes the ultimate creative power of the Universe the Primeval Energy, or Maya, or Shakti as *aghaṭana-ghaṭyanā-paṭīyasī*, which means that it is capable of making things happen in this relative world of space-time-causality without any cause. It also means that things may not happen in the same relative world despite a sure cause. It may be hard to believe this through

22. *Physics and Beyond,* p.63.

ordinary logic, but it is nevertheless true. This is an age-old postulate of Vedantins. Vivekananda explains this idea :

'Cause and effect are all Maya, and we shall soon grow to understand that all we see is disconnected as the child's fairy tales now seem to us. There is no such thing as cause and effect and we shall come to know of it. Then if you can, lower your intellect to let any allegory pass through your mind without questioning about connection.'[23]

In fact, when Vivekananda first read Alice in Wonderland, he commented that the book was one of the profoundly Vedantic visions of life. Causality or determinism in this world is as unreal as the relative space-time-world itself. Niels Bohr admitted that today physicists feel 'the necessity of a final renunciation of the classical ideas of causality and a radical revision of our attitude towards the problem of physical reality...'

Einstein could never accept the unsurmountable incertitude regarding our knowledge of the electron movement. If we know a base ball, or an automobile, why not the electron also? The oft-spoken protest which would come out of his lips was, **'God does not throw dice.'** Einstein was so antagonistic to quantum indeterminacy that his friend Paul Ehrenfest, a physicist from Leyden in Holland, said, 'Einstein, I am ashamed of you. You are arguing against the quantum theory as your opponents argue about your relativity theory'.[24] And when he stood obstinately on his idea that God does not play dice, Niels Bohr one day gave Einstein his unforgettable answer, **'Nor is it our business to prescribe to God, how he should run the world.'**[25] Yet, Einstein did not budge an inch. And when he died, Max Born, Einstein's disciple, wrote that he died with a sense of tragedy. Heisenberg's Uncertainty Principle had far reaching repercussions which are being increasingly felt today. It is this discovery which,

23. *Complete Works,* Vol.7 p.88.

24. *Physics and Beyond,* p.80.

25. *Physics and Beyond,* p.81.

in fact, related modern physics directly to the mystical traditions of Vedanta Philosophy. Fritjof Capra's remark in one of the latest books on the developments of physics is an eye-opener to us.

'Mysticism is thought of in the scientific community as something very vague, describing something fuzzy, nebulous, and highly unscientific. Now to see one's cherished theories compared with this highly unscientific activity is threatening to physicists... . But ultimately they regarded it as a great intellectual and cultural enrichment of their lives.

'First and foremost was Heisenberg. I had several discussions with him. I lived in England then, and I visited him several times in Munich and showed him the whole manuscript chapter by chapter (Tao of Physics). He was very interested and very open, and he told me something that I think is not known publicly, because he never published it. He said that he was well aware of these parallels (with Eastern mysticism). **While he was working on Quantum theory, he went to India to lecture and he was a guest of Tagore. He talked a lot with Tagore about Indian philosophy. Heisenberg told me that these talks had helped him a lot with his work in physics, because they showed him that all these new ideas in Quantum theory were in fact not all that crazy. He realised there was, in fact, a whole culture that subscribed to very similar ideas. Heisenberg said that this was a great help for him. (Niels Bohr had a similar experience when he went to China.")**

26. The Holographic Paradigm and Other Essays : Exploring the leading Edge of Science: Shambhala publications, 1982. p.217-218.

5

RELATIVITY AND MAYA

Galilean Relativity

THE concept of 'relativity' was known long before Einstein. When we are traveling on a train, another train coming from the opposite direction appears to be travelling faster, whereas a train moving in the same direction appears to move slowly or to be even motionless. And within the compartment, it is often difficult to feel the motion of our own train. Newton formulated these common experiences in the form of a dictum : 'The motions of bodies included in a given space are the same among themselves, whether that space is at rest or moves uniformly forward in a straight line.'[1] This is known as Galilean or Newtonian Relativity Principle.

This principle can also be phrased in more general terms as follows : mechanical laws which are valid in one place are equally valid in any other place which moves uniformly relative to the first. If two frames of reference have a constant relative velocity (i.e. speed in a particular direction) then, if the rules of Newtonian mechanics hold good for events measured in one frame of reference (say, the firing of a gun), they will also hold good

1. Quoted in Lincoln Barnet, *The Universe and Dr. Einstein* (London: Collins, 1956) pp. 37-38.

in the other. Such frames of reference are called Galilean frames of reference.

It is impossible to speak about the motion of an object without reference to some stationary point or place. To say that a car is moving at a speed (or velocity, if direction is also included) of 50 kph is meaningless unless the speed is related to some other body which provides the frame of reference, as for example the earth. Newton, of course, knew that the earth is in motion, but he believed that somewhere beyond the stars there must be a body absolutely at rest. He also seems to have held space itself to be a universal frame of reference. This belief in the absoluteness of space is one of the main pillars of Galilean Relativity.

The development of the wave theory of light, however, made scientists assume in the next two centuries that space was not empty but was filled with a hypothetical substance called ether. Just as sound was propagated as air waves, light was propagated as 'ether-waves'. It was then that James Clerk Maxwell propounded the theory that light was the propagation of electromagnetic fields through empty space. 'The electromagnetic fields', he wrote, 'are not states of a medium and are not bound down to any bearer, but they are independent realities which are not reducible to anything else.[2]

It was the attempt to accommodate Maxwell's theory within the rigid walls of Newtonian physics that led to the latter's overthrow and the development of Einsteinian Relativity.

In Newtonian mechanics, the calculation of relative velocities is very simple. For example, to an observer sitting in a train moving at 30 kph and being overtaken by another train moving

2. Quoted in Gary Zukov, *The Dancing Wu Li Masters* (New York : Morrow Hill Paperbacks. 1979) p. 156.

at 70 kph, the second train appears to be moving past him at the *relative* speed of 40 kph. If it is travelling at 70 kph in the opposite direction, it will appear to pass him at the relative speed of 100 kph. Now, if the laws of Newtonian physics were universally true, they should apply outside the earth also. The speed of light through the earth is constant - 300,000 kilometers (186,000 miles) per second. Is it the same beyond the earth also?

The German-born American Physicist Albert Michelson, in collaboration with his American friend Edward Morley, decided to find this out in 1881. Since the earth travels round the sun, a beam of light coming from a source ahead of the earth should appear to travel faster than a beam of light catching up on the earth from a source behind it. The difference should be detectable by careful measurement. Michelson and Morley designed a special instrument known as the interferometer which could (in the place of clock) accurately compare the velocities of two beams of light travelling in two different directions. However, even after repeated trials (in which the greatest care was taken to eliminate errors), they found no difference whatsoever between the velocities of the beams of light, regardless of their direction. The velocity of light was found to be always fixed, as if the earth were not moving. But every one knows that the earth is in constant motion.

Several hypotheses were at first advanced to explain the fixity of the velocity of light. The Irish physicist FitzGerald and the Dutch physicist Lorentz independently hypothesized that a body travelling through the ether was foreshortened in the direction of travel by the 'ether wind' by a ratio that increased with the increasing speed. Lorentz also stated that if a clock (instead of an interferometer) were used, the clock moving through ether would slow down compared to a clock at rest in ether because of the ether wind. This phenomenon is known as FitzGerald-Lorentz contraction.

The Special Theory of Relativity

Einstein followed a totally different approach to the problem. He rejected the existence of ether itself, and held that : (1) it is motion itself, not the ether wind, that causes the contraction of the measuring rod; (2) that it is motion itself which is responsible for the constancy of the velocity of light. Einstein looked upon the fixity of the velocity of light as a universal law. If the velocity of light is constant regardless of the earth's motion, he reasoned, it must be constant regardless of the sun, the stars, the galaxies etc. From this he came to the conclusion that the laws of nature are the same for *all uniformly moving systems.* This is the essence of Einstein's Special Theory of Relativity. It includes the Galilean Relativity Principle which states that only mechanical laws are the same for all uniformly moving systems. Einstein's relativity theory includes not only mechanical laws but also the laws governing light and electromagnetic phenomena.

At first it might appear that there is nothing startlingly new in Einstein's Special Theory of Relativity. As a matter of fact, the popular notion that every concept in Einstein's theory is new and original is wrong, for, as we have seen, his generalization is based on several earlier concepts. But Einstein did make original deductions which are of a revolutionary nature and of immense consequences. He explained the results of Michelson's experiment without the help of the ether wind. He rejected the absolute character of space and time.

Newton showed the relativity of motion but Einstein showed the relativity of time. In fact, this is the fundamental difference between the two concepts of relativity, Galilean and Einsteinian. Newton had assumed that the clocks in inertial frames of reference go at the same rate. So time is the same everywhere (of course making due adjustments appropriate to different zones on earth). If a certain physical process takes one hour in one

rtial frame of reference, it will take one hour in every frame reference. And if two events are observed to take place nultaneously by an observer attached to one frame, they will ɪpear simultaneous to observers attached to all other frames. he universality of time and time determination is referred to s the 'absolute character of time'. Einstein realized that the otion of simultaneity, deeply rooted in man's consciousness, is ɪ key concept. To know that two events have taken place at wo different places at the same time we must see both simultaneously and, if these places are too far apart, the knowledge must be communicated to us instantaneously. This cannot be done through telephone, telegraph, wireless or light signalling, because the message conveyed through all these processes takes time to reach us. If we could transmit signals at infinite velocities, we could know the two events simultaneously. But, actually, there is no known method of signalling faster than light (or any other form of electromagnetic radiation) - more than 300,000 km per second. The velocity of light is the ultimate limiting velocity of the universe. Therefore it is impossible *to know* the simultaneity of occurence of two events in two distant places. In other words, time is dependent on the inertial frame of reference and is therefore relative, not absolute.

This does not, however, mean that since everything in the universe is relative, it is not possible to know of any event other than those connected with our own frame of reference. Lorentz had earlier worked out mathematical equations by which space and time measurements made in one uniformly moving system could be correlated with measurements in another system. Einstein modified these equations (called 'Lorentz transformation') by introducing the principle of the limiting velocity of light into them. If we know the result of one physical experiment in one moving system (everything in the world is moving) it is not necessary to repeat the same experiment in another moving

system. With the help of Lorentz transformation, as modified by Einstein, it is possible to calculate the values in any other moving system.

Einstein did not merely show that space and time are relative but united them into a single continuum. In our minds we tend to separate these two, for our awareness of space and awareness of time are different. Space is described in three dimensions - length, breadth and thickess. The unit of measurement for all these dimensions is the same - foot or metre. To unite space and time, time is to be regarded as the fourth dimension. But the unit for measuring time - second or hour - is quite different from that for space. Hence we find it difficult to think of space-time as one integral whole. But in practical life we actually do this when we speak of somebody living 'within twenty minutes of downtown by bus', or of some place 'five hours away by train'.

The German mathematical physicist Hermann Minkowsky had earlier attempted to unite space and time into a continuum with the help of Euclidean geometry. Einstein used the velocity of light in order to weld together space and time, and with the help of Riemann geometry, extended the significance of the continuum far beyond what Minkowsky had imagined.

The universe consists of not only space and time but also matter. Einstein's Special Theory of Relativity revolutionized man's conception of matter. Physicists use the term mass when they refer to matter quantitatively. Mass is popularly identified with weight. But for physicists mass is the resistance (inertia) of matter to a change of motion (that is, to acceleration). It is easier to push a cycle than an automobile, for the latter resist motion more than the former. In classical physics the mass of a body is fixed and unchanging. But Relativity asserts that the mass of a body increases with the increase in its velocity. The

change in mass of a body produced by its motion is called 'relativistic mass'.

By further deduction from his principle of the reactivity of mass, Einstein came to the remarkable conclusion that mass can be changed into energy and energy can be changed into mass. This finding is embodied in the famous equation $E = mc^2$, where E is energy, m is mass and c is the velocity of light. The bizarre proof of this principle and its calamitous consequences produced by the atom bomb are too well known to need mention here.

General Theory of Relativity

The Special Theory covered only objects and frames of reference which move at constant velocities. But most bodies undergo frequent change in velocity known as acceleration. The space-time concepts of the Special Theory had also to be extended from the field of electromagnetic phenomena to all physical phenomena, especially the universal and mysterious phenomenon of Gravitation. Therefore Einstein enlarged the Special Theory (propounded in 1905) into the General Theory of Relativity in 1916. The foundation of this theory is the Principle of Equivalence of Gravitation and Inertia enunciated by Einstein. Simply stated, the principle means that there is no way to distinguish the motion produced by inertial forces (acceleration, recoil, centrifugal force, etc.) from motion produced by gravitational force. This means that even accelerated motion is relative; it can be judged only with reference to some system of reference. As an extension of the Special Theory, the General Theory of Relativity may be stated as follows : 'The laws of nature are the same for all systems *regardless of their state of motion*'.[3]

From the above discussion one important point emerges. The uniqueness and greatness of Einstein lie not merely in showing the relativity of all phenomena but in establishing the universal validity of the fundamental physical laws of physics. He did not merely say that everything in the universe is relative, but showed

how, with the help of the velocity of light and the Principle of Equivalence, we could gain a precise knowledge of the physical phenomena, in spite of their relativity. The universe that he has pictured is not a chaos but a cosmos. He found unity in diversity and meaning in the apparently meaningless phenomena of the universe.

There is only one field, one inscrutable world, where this harmony and certitude do not seem to prevail. It is the microworld of subatomic particles. Harmony and certainty can occur only when phenomena are causally interrelated. But as we have seen, Heisenberg's Uncertainty Principle has given a blow to the notion of rigid causal relations in quantum mechanics.[4] Einstein, who firmly believed that 'God does not play dice', could not till the end of his life accept the above view. He strove, without success, to unite relativity, quantum mechanics and nuclear science within one unified theory. Though the Special Theory of Relativity has been applied to quantum phenomena by Paul Dirac and others, the General Theory still remains outside the micro realm.

Maya and Space-Time

One of the fundamental concepts of Advaita Vedanta is its theory of Maya. It is also its most controversial one. Maya is not mere illusion or ignorance understood in a worldly sense. Swami Vivekananda correctly characterized it as 'a statement of fact'. 'What you call matter or spirit or mind or anything else you may like to call them, the fact remains the same, we cannot say that they are, we cannot say they are not...A fact, yet at the same time, not a fact. This is a statement of facts, and this is what is called Maya.'[5]

3. *The Universe and Dr. Einstein, p. 76.*
4. See, *The Uncertainty Principle and the Omnijective Reality,* Chapter 4 of this book.
5. *The Complete Works of Swami Vivekananda* (Calcutta : Advaita Ashrama, 1976) Vol.2 p. 112.

Samkara had identified Maya with space, time and causation - *deśa, kāla, nimitta*. Swami Vivekananda followed Samkara's theory of Maya but gave it a thoroughly modern logical formulation. Long before Einstein, he clearly stated the relativity of time and space. In the following statement he advances concepts which come so very close to those of Einstein:

The one peculiar attribute we find in time, space and causation is that they cannot exist separate from things. Try to think of space without colour or limits or any connection with the things around - just abstract space. You cannot. You have to think of it as the space between two limits, or between three objects. It has to be connected with some object to have any existence. So with time; you cannot have any idea of abstract time [or absolute time, as Einstein put it - *author*] but you have to take two events by the idea of succession. Time depends on two events, just as space has to be related to outside objects. And the idea of causation is inseparable from time and space.[6]

Maya was posited by Samkara in order to explain the existence of the phenomenal universe. The theory of Maya was a logical necessity. At the same time, he could not deny the principle of evolution in the phenomenal world. To reconcile evolution with Maya, the followers of Śaṁkara developed the doctrine of Apparent Transformation *(vivarta vāda)*. Dualists like the followers of Śaṁkhya and theists, adopted the doctrine of Real Transformation *(pariṇāma vāda)* according to which the world is the result of actual transformation of the ultimate reality. Explaining the *vivarta vāda* Swami Vivekananda stated:

According to the Advaitist proper, the followers of Shankaracharya, the whole universe is the *apparent* evolution of God. God is the material cause of this universe, but not really, only apparently. The celebrated illustration used is that of the rope and the snake, where the rope appeared to be the snake,

but was not really so. The rope did not really change into the snake. Even so, this whole universe as it exists is that Being. It is unchanged, and all the changes we see in it are only apparent. These changes are caused by Desha, Kāla and Nimitta (space, time and causation) or according to a higher psychological generalization, by Nāma and Rūpa (name and form). It is only by name and form that one thing is differentiated from another....Again, it is not, the Vedantists say, that there is something as phenomenon and something as noumenon. The rope is changed into the snake appearently only; and when the delusion ceases, the snake vanishes.[7]

Maya and consciousness

It is doubtful whether Einstein would have gone so far with Vivekananda in accepting the theory of Maya. But another great physicist, Erwin Schrodinger, did. In a famous talk which he gave at the Cambridge University soon after the Second World War, Schrodinger said:

Consciousness is never experienced in the plural, only in the singular... How does the idea of plurality (so emphatically opposed by the Upanisad writers) arise at all?

Consciousness finds itself intimately connected with, and dependent on, the physical state of a limited region of matter, the body...Now there is a great plurality of similar bodies. Hence the pluralization of consciousness or minds seems a very suggestive hypothesis. Probably all simple, ingenuous people, as well as the great majority of Western philosophers, have accepted it...The only possible alternative is simply to keep the immediate experience that consciousness is a singular of which the plural is unknown, that there is only one thing and that, what seems to be a plurality,

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6. *The Complete Works of Swami Vivekananda,* Vol.2 pp. 135-36.

7. *Complete Works,* Vol.1. (1977) p. 363.

is merely a series of different aspects of this one thing produced by a deception (the Indian Maya) - the same illusion is produced in a gallery of mirrors, and in the same way Gaurishankar and Mt. Everest turned out to be the same peak seen from different valleys.[8]

We have seen that Einstein's greatest achievement consisted not in showing that everything is relative but in discovering the way to truth through the relative world, in establishing the absolute validity of fundamental physics laws in spite of relativity. In a similar way, Vedanta does not simply describe the world as Maya and leaves you there, but shows you the way to the Truth, the absolute nature of consciousness.

Einstein abandoned the hypothesis of ether in his search for higher truth, higher generalization. The Indian sages too had discovered something similar to ether, the elemental *ākāsa*, but they went far beyond that and discovered **consciousness as the ultimate Reality** : *prajnañām brahma.* Says Swami Vivekananda:

If the theory of ether failed in ancient times to give a solution of the mystery of the universe, working out the details of that ether theory would not bring us much nearer to the truth...What I mean is that, in inquiry into the principle, the Hindu thinkers were as bold as, and in some cases much bolder than, the moderns. They made some of the grandest generalizations that have yet been reached, and some still remain as theories, which modern science has yet to get even as theories. For instance, they not only arrived at the ether theory, but went beyond and classified mind also as a still more rarefied ether. Beyond that again, they found a still more rarefied ether. Yet that was no solution, it did not solve the problem.[9]

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8. Erwin Schrodinger, *What is Life* (London Cambridge University Press, 1948)

9. *Complete Works,* Vol. 2. p. 90.

They found the solution by going beyond even the more rarefied ether or Maya, and by discovering the Absolute - the infinite, immutable, non-dual consciousness beyond all relativity, beyond all contradiction. Wherever there is contradiction there is relativity, there is Maya. The great first-century Buddhist philosopher Nagarjuna used the attribute of contradictoriness to show the illusory nature of the phenomenal world. Teachers of Advaita Vedanta went one step further and, using non-contradictoriness as the test of absolute truth, discovered Brahman as the ultimate Reality.

The contradictory nature of the phenomenal world according to quantum physics and Vedanta

Modern physics has ended in the finding that the apparently hard reality of matter is, in the quantum world, a mere shadow. Electron is only a 'probability wave'. And this concept leads, says physicist Fritjof Capra '**to another pair of opposite concepts which is even more fundamental, that of existence and non-existence...we can never say that an atomic particle exists at a certain place, nor can we say it does not exist. Being a probability pattern, the particle has tendencies to exist in various places and thus manifests a strange kind of physical reality between existence and non-existence.**[10]

These words seem like an echo of what Vivekananda said in London at the end of the last century, "This world has no existence". What is meant by that? It means that it has no absolute existence. It exists only in relation to my mind, your mind and to the mind of everyone else.'[11]

Nobel physicist Robert Oppenheimer expresses this basic contradiction, this fundamental incertitude in our knowledge of

10. Fritjof Capra, *The Tao of Physics* (Berkeley : Shambhala 1973) p. 153.

11. *Complete Works*, Vol.2 p. 91.

the world: 'If we ask, for instance, whether the position of the electron remains the same, we must say "no"; if we ask whether the electron is at rest we must say "no"; if we ask whether it is in motion, we must say "no"'.[12]

These words seem like an echo of what an ancient Upanisadic seer uttered with equal force about Brahman, the ultimate Reality behind the phenomenal world :

It moves. It moves not.

It is far, and yet it is near

It is within all this

And it is outside all this.[13]

The Katha Upanisad describes the ultimate Reality as 'smaller than the smallest and yet greater than the greatest'. In the same strain writes the Christian Mystic Nicholas de Cusa : '...the walls of the Paradise in which Thou Lord dwellest is built of contradictories.' And Dionysius the Areopagite : 'He is both at the root and in motion, and yet is in neither state.'[14] 'Thus we find', says Vivekananda, 'that Maya is not a theory for the explanation of the world. It is simply a statement of facts as they exist, that the very basis of our being is contradiction, that everywhere we have to move through this tremendous contradiction.'[15]

A man walking on the desert continues to see a lake although he knows it is only a mirage. The physicist tries to look at a subatomic object as particles although he realizes that the particle has already dematerialized into what particle physicists describe as 'interconnected patterns of dynamic energy', or, as physicist

12. Quoted in *The Tao of Physics*, p. 154.
13. *Isa Upanisad, 5.*
14. Quoted in HustonSmith, *Forgotten Truth : The Primordial Tradition* (Harpet Colophone books, 1978) pp. 108-9.
15. *Complete Works*, Vol.2. p. 87.

David Bohm likes to call it, a 'holon', a particle holographically connected with the entire universe. The whole universe is an 'implicate order' as Bohm puts it, where there is always a deeper unity underlying the surface. The individual electron as a particle is thus both real and unreal. The microcosm may sometimes behave as a particle, and sometimes it may also indicate that it is an inextricable part of the macrocosm. Modern physics has stepped into the world of a number of bewildering contradictions where particles behave as waves, and waves as particles; where a single particle is also a reflection of the whole universe; where objective reality, though apparently real is yet illusory; where we know what happens at the end of the reaction, but never know in exactitude how it happens because subatomic phenomena are like 'an unopenable watch' as Einstein said. To be aware of these basic contradictions in our knowledge of Reality, and in life, is to be aware of Maya. The struggle to go beyond the contradictions is the spiritual struggle. To succeed in this struggle is the attainment of Nirvana or Samadhi. But as long as we act, live and think in this eversense-bound world, we shall be compelled to live only in the midst of everlasting contradictions which go by the name Maya.

Vivekananda exposes the inescapable limitations of our intellect and the indomitable desire for knowledge in men struggling in a world of space-time-causality.

So with our intellect. In our desire to solve the mysteries of the universe, we cannot stop our questioning, we feel we must know and cannot believe that no knowledge is to be gained. A few steps, and there arises the wall of beginningless and endless time which we cannot surmount. A few steps, and there appears a wall of boundless space which cannot be surmounted, and the whole is irrevocably bound by the walls of cause and effect. We cannot go beyond them. Yet we struggle, and still have to struggle. And this is Maya.[16]

16. *Complete Works,* Vol.2. p. 119.

How to go beyond Maya? How to resolve contradictions? Vedanta says - by realizing that Absolute which is above and beyond the contradictions of the world of Maya. And this Absolute is not a personal God sitting somewhere on the clouds, but the self-luminous infinite consciousness everpresent inside every being. It is only by realizing the Absolute within that all contradiction ceases. This is the unanimous declaration of all the Upanisads. And Vivekananda concludes his exposition of Maya with this very idea of the Absolute within each of us.

We see, then, that beyond this Maya the Vedantic philosophers find something which is not bound by Maya; and if we can get there, we shall not be bound by Maya. This idea is in some form or other the common property of all religions. But, with Vedanta, it is only the beginning of religion and not the end. The idea of Personal God, the Ruler of Maya, or nature, is not the end of these Vedantic ideas; it is only beginning. The idea grows and grows until the Vedantist finds that he who, he thought, was standing outside, is he himself and is in reality within.[17]

Attempts to go beyond the phenomenal world to the Absolute is not just a philosophical speculation. It is a part of man's spiritual quest through all the ages. Man can and does reach that stage. Says Vivekananda, 'The Jñāni takes nothing for granted; he analyses by pure reason and force of will until he reaches Nirvana which is the extinction of all relativity. No description or even conception of this state is possible'. Nearly 60 years after Vivekananda's passing away, physicist David Bohm concludes his book *Causality and Chance in Modern Physics* (Introduction by Nobel physicist de Broglie) with an identical observation. **'The essential character of scientific research is, then, that it moves towards the Absolute by**

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17. *Complete Works,* Vol.2. p. 104.

studying the relative, in its inexhaustible multiplicity and diversity.'[18] In a sense, through Relativity and Quantum Mechanics, modern science has already reached the door of the 'transcendental' realm. Writes Milic Capek : 'To deny the transcendent qualities would be as uncritical as for a blind person to deny colours, for a deaf person to deny sounds, or for human beings to deny qualities which some animals undoubtedly experience under the impacts of ultrasonic waves or ultraviolet rays.'[19]

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18. David Bohm, *Causality and Chance in Modern Physics* (London : Routeledge and Kegan Paul Ltd. 1957) p. 170.

19. Milic Capek, *The Philosophical Impact of Contemporary Physics* (Princeton, New Jersey : D. Van Nostrand Co. Inc. 1961). p. 369.

6

INTUITION - THE COMMON BASIS OF SCIENCE AND VEDANTA

1. *Vivekananda speaks in the language of physics*

THE inevitable confluence of modern physics and Vedantic metaphysics was one of the truths which Swami Vivekananda repeatedly pointed out during the period of his preaching Vedanta in the West and the East right from 1893 to the end of 1900. Nikola Tesla, the famous U.S. electrical engineer and inventor was deeply impressed by Vivekananda's exposition of the oneness of matter or *ākāśa* and energy or *prāṇa* in his lectures on Raja Yoga delivered in New York in 1896.

Today after more than eighty years writers on modern physics are finding in Vivekananda's explanation of ancient Vedanta a close resemblance to the language of today's physics. Amaury de Reincourt in his recent book on modern physics entitled, *The Eye of Shiva,* finds that in Vivekananda's interpretation 'Indian mysticism has evolved...as the science of physics itself.' And this, he states, 'points towards an inevitable convergence of the two.'[1]

Michael Talbot in his book entitled, *Mysticism and New Physics,* compares the space-time concepts of Vivekananda with

1. Amaury de Reincourt, *The Eye of Shiva* (New York : William Morrow & Co. 1981) p.190.

those of the father of space-time continuum idea, Herman Minkowski. After quoting Vivekananda's idea of space-time Talbot writes,

The remark was originally made by mystic S. Vivekananda in Jnānā Yoga, but the fact that the names of the mathematician who first theorized that space and time are a continuum, Herman Minkowski, and the greatest of the historical Brahmin sages, Advaita, are interchangeable, demonstrates once again the confluence of mysticism and the new physics.[2]

It seems obvious that the author mistakes the term 'Advaita' for the name of a person. But the similarity between the ideas of Vivekananda and those of Minkowski strikes him deeply, and Talbot continues,

Vivekananda further expresses a view that has become the backbone of quantum theory. There is no such thing as strict causality.[3]

Vivekananda's ideas are proving prophetically true. Modern physics which began on the foundations of positivism or experimental verification of external objects is moving towards an intuitive understanding of the real nature of things. Material reality today appears not only beyond the capacity of senses but even beyond the capacity of ordinary human imagination. The dematerialization of matter leads naturally towards a convergence of modern physics and Vedanta philosophy.

Vivekananda himself predicted that Western science which seeks to control everything by controlling the external reality is inextricably connected with the control of internal nature:

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2. Michael Talbot, *Mysticism and New Physics* (New York : Bantam Books, 1980) p.114.

3. op cit p.115

Some say that by controlling internal nature we control everything. Others that by controlling external nature we control everything. Carried to the extreme both are right, because in nature there is no such division as internal or external. These are fictitious limitations that never existed. The externalities and the internalities are destined to meet at the same point, when both reach the extreme of their knowledge. Just as a physicist when he pushes his knowledge to its limits, finds it melting away into metaphysics, so a metaphysician will find that what he calls mind and matter are apparent distinctions, the reality being One.[4]

The search for the real nature of things through an investigation into external physical nature - this was the traditional Graeco-Roman or the Western method of knowledge. The Eastern or the Indian method was to search after reality through an investigation into the internal nature of man, which Vivekananda described as 'that introspective search after divinity' which left its 'peculiar stamp' upon the whole cycle of Upanishadic or Vedantic philosophy. In the Western tradition saints have been painted as looking upward to the skies for God while in the Eastern tradition a *ṛṣi* or a yogi is painted with his eyes closed. He is searching for the ultimate reality beyond the sensory levels of existence. His meditation is supersensory and therefore essentially transcendental in nature. As the *Katha Upaniṣad* succinctly puts it, 'The wise man desiring immortality turns his gaze inward and realizes the indwelling Self.'[5]

The uniqueness of Vivekananda lies in the significant fact that he is the only one in modern times who accepted both the external and internal ways of investigation as equally valid means to the

4. *The Complete Works of Swami Vivekananda* (Calcutta : Advaita Ashrama. 1977) 1:131 (henceforward cited as *Complete Works*)

5. कश्चिद्धीरः प्रत्यगात्मानमैक्षदावृत-चक्षुरमृतत्वमिच्छन् *Katha Upanisad* 2.1.1

realization of the ultimate reality. He not only saw no contradiction between them but found them complementary. He was the first great modern thinker to point out the common experiential ground between Vedanta and science. In his lecture on the Methods and Purpose of Religion, he clarifies this point with a rare conviction and authority :

I do not mean that those who want to search after truth through external nature are wrong, nor that those who want to search after truth through internal nature are higher. These are the two modes of procedure. Both of them must live; both of them must be studied; and in the end we shall find that they meet. We shall see that neither is the body antagonistic to the mind, nor the mind to the body, although we find many persons who think that this body is nothing. In old times, every country was full of people who thought this body was only a disease, a sin, or something of that kind. Later on, however, we see how, as it was taught in the Vedas, this body melts into the mind and the mind into the body.[6]

2. *Positivism ends in intuitionism*

Positivism is the philosophy which refuses to accept any thing which is not verifiable by senses or experiments. It rejects all metaphysical speculations as unnecessary. August Comte and d'Alembert formed the powerful vanguard of positivism in the West in the 18th century. Positivism soon came to be associated with empiricism, a school of thought which holds that sense-experience is the only source of knowledge.

Einstein began his life as a positivist. In his early years at Zurich, Einstein fell under the intellectual influence of the Austrian physicist-philosopher Ernst Mach, a major advocate of positivism in physics. Mach taught that, 'Theoretical physicists

6. *Complete Works* 6 (1978) : 4

should never use any idea in physics which cannot be given a precise, direct meaning through experimental operations. Ideas without connection to the empirical world were deemed superfluous to physical theory.'[7] As a forerunner of logical positivism Mach said, 'Science may be regarded as a minimal problem consisting of the completest presentation of facts with the least possible expenditure of thought.'[8] Einstein explicitly acknowledged his intellectual debt to Mach.[9] During his early years Einstein thought that physics should deal with those things only which are verifiable by senses. That is why he defined Space as that which could be measured with rods. That is why he defined time as that which could be measured with a clock. That is why he rejected the age-old belief in 'ether' as the absolute frame of reference when despite repeated experiments Michelson-Morley's interferometer failed to detect its presence.

Whether physics should be based on positivism and should deal only with things which are verfiable by experiments became a controversial question after Heisenberg's discovery that the very fact of observation alters the nature of observation or the result of experiment. Physicists who held to positivism began to argue against the 'microphysical indeterminacy' of Heisenberg. Karl R. Popper wittily observed that Heisenberg himself 'tries to give a causal explanation why causal explanations are impossible.'[10] Alfred North Whitehead criticized Heisenberg's indeterminacy principle and the 'tendency to give an extreme subjective interpretation to this new doctrine' by young physicists like

7. Cf Heinz R. Pagels, *The Cosmic Code* (New York : Bantam Books, 1983) p. 39-40

8. Quoted in Edward O. Wilson *On Human Nature* (Harvard Univ. Press, 1978) p.12

9. Milic Capek, *Philosophical Implications of Contemporary Physics* (Princeton : D. Van Nostrand Co. 1961) p.297

10. Ibid

Schrodinger, Wigner, Wheeler and others. Whitehead said, 'But it is the observer's body that we want, and not his mind...on the whole, it is better to concentrate attention on Michelson's interferometer and to leave Michelson's body and Michelson's mind out of picture.'[11]

The sheer weight of the new discoveries in physics and also the recognition of intuition in his own self, gradually forced Einstein to move away from positivism. Probably Plank influenced him in this transition. In a letter to his philosopher friend, Maurice Solovine, he described with a diagram what is known as 'Einstein's postulation method'.[12] By an 'intuitive leap' he sought to fly from sensory experience and set up an 'absolute postulate' in the first place. This 'absolute postulate' is a creation of pure intuition. It is never derived from experience or experiments. That is why he wrote, 'For the creation of a theory, the mere collection of recorded phenomena never suffices - there must always be added a free invention of the human mind that attacks the heart of the matter.'[13]

Heisenberg, to whom positivism was the 'greatest philosophical opponent', rejected it at the very outset. 'Positivism makes the mistake of refusing', writes Heisenberg, 'to see the overall connection and of wanting to deliberately keep them in the dark.'[14] Vivekananda foresaw the inevitable frustration of a science which has for its foundation nothing but sensory experiences. He said, 'The senses cheat you day and night. Vedanta found that ages ago; modern science is just discovering

11. Ibid. p.304
12. Cf *The Cosmic Code*, p.40.
13. Ibid. p.41
14. Armin Hermann. *Heisenberg* Reinbek bei Hamburg Rowohlt Taschenbuch Verlag Gmbh. 1976) p.108

the same fact.'[15] This Vivekananda said in 1895 to the westerners.

Both theoretical and experimental physicists today are gradually turning towards the abstract and the intuitive. Mathematics is becoming the tool of physics, and mathematics is the language of the abstract. In fact, modern physics is turning more and more 'crazy' and less and less experimentally verfiable. Heinz Pagels tells us of a remarkable occasion when Wolfgang Pauli went to deliver a lecture on Heisenberg's theory at the Puplin laboratory in Columbia University. When the lecture was over Niels Bohr, who was one among the audience, shouted out to Pauli that the theory could not be right because 'It is not crazy enough.' Pauli at once answered with the same humour, 'It is crazy enough.' Both were outstanding physicists of this century and both 'knew that the craziness of the quantum theory turns out to be right.' 'Theoretical physicists', writes Pagels, 'swim in a sea of ideas.'[16]

By the 1950s, especially after the Everette-Wheeler interpretation of quantum theory of 1957 which is also known as the Many-Worlds Interpretation, mind or consciousness began to gain more importance than the machine in the physicists' conception of the universe. While Heisenberg asserted that the outcome of any microphysical experiment is linked with the mind of the scientist, Eugene Wigner, Nobel physicist in 1961, went a step further and asserted that 'it is impossible to give description of quantum mechanical principle without explicit reference to consciousness.'[17]

Primarily a theoretical physicist, Einstein found in the language of mathematics the vehicle of grasping the reality which is

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15. *Complete Works,* 7 (1972) : 74

16. *The Cosmic Code,* p.304

17. *Mysticism and New Physics,* p.34

supersensory. Physics today is bound to transcend, as Einstein thought, 'the rattle of the senses'.[18] Einstein said, 'But the creative principle resides in mathematics. **In a certain sense, therefore, I hold it true that pure thought can grasp reality as the ancients dreamed.'**[19]

With the help of this power of 'pure thought' or 'intuitive leap' Einstein made strange postulates such as the equivalence of gravity and acceleration, the principle of invariance, time-dilation, space-contraction, deflection of light by the gravitational field, etc. Most of these postulates later on got experimentally verified. Though he began as a positivist, Einstein became one of the most outstanding intuitive minds in human history. 'If Einstein had remained a positivist, I doubt that he would have discovered general relativity', writes Heinz R. Pagels.[20]

The Japanese Nobel physicist Hideki Yukawa intuitively predicted the existence of an unknown subatomic particle to account for the super-binding strength of the strong-interaction force which holds the nucleus together. After twelve years of research the particle predicted was discovered in 1947 and it was called pimeson or pion. Yukawa had been brought up in the oriental tradition which taught him the superiority of intuition over logic and experiments. In his book on *Creativity and Intuition* Yukawa writes,

A thorough-going rationalism eludes them (the oriental and the Chinese)... in particular, the development of physics since the beginning of twentieth century has taken this kind of course. In this kind of course nothing can be done by logic alone. The only

18. Lincoln Barnett, *The Universe and Dr. Einstein* (London : Comet Books/Collins. 1956) p.118

19. Quoted in *The Cosmic Code,* p.24

20. Ibid, p.40

course is to perceive the whole intuitively and see through what is correct...the fact remains that in order to synthesize contradictions it is necessary first to survey the whole with intuition.

And again he writes,

In short by supplementing what he (the scientist) already has with his imagination, he produces an integral whole. If he succeeds in the attempt, the contradictions will be resolved...for us the scientists, the power of imagination is as important ingredient.[21]

The ancient seers of India evolved a number of concepts on space, time, causality, matter, energy, the origin of our universe, and the limitations of reason, which are in striking conformity with the ideas of modern physicists. How did they do this? Certainly not through telescopes or electron microscopes. Their only technique was meditation, which opened the door to higher intuition or pure imagination that transcends reason but never contradicts it. Swami Vivekananda said, 'Imagination will lead you to the highest even more rapidly and easily than reasoning.'[22] He never stood against reason; but pointed out that intuition is the natural culmination of reason. This is the basic methodology of Vedanta. Swamiji explains it as follows :

Religion is above reason, supernatural. Faith is not belief, it is the grasp on the ultimate, an illumination...Stick to your reason until you reach something higher; and you will know it to be higher, because it will not jar with reason...All religion is going beyond reason, but reason is the only guide to get there. Instinct is like ice, reason is the water, and inspiration is the subtlest form of vapour, one follows the other.[23]

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21. Hideki Yukawa, *Creativity and Intuition* (Tokyo, New York, San Franscisco : Kodansha International) p.57-58

22. *Complete Works,* 7 : 100

23. Ibid. p.60

3. *Indeterminacy and the Atman = Brahman equation*

In was Einstein who deeply impressed young Heisenberg with the radical idea that the 'experiment-observation-inference' method was 'nonsense'. Einstein said, 'It is the theory which decides what can be observed.'[24] But when Heisenberg built up the 'uncertainty principle' on the Einsteinian idea, Einstein refused to accept it until the end of his life. He intensely believed unto the end in the existence of a strictly deterministic order in the running of the universe.

While Einstein refused to accept indeterminacy, another Nobel physicist, Erwin Schrodinger, took it up to build a bridge to one logical conclusion of Vedanta philosophy. Schrodinger goes deeper and rejects, contrary to most western scientists, the idea that '*Quantum indeterminacy* plays no biologically relevant role in them.'[25] Almost in the style of a Vedantic philosopher he shows how unreasonable it would be for a scientist to reject Heisenberg's indeterminacy. After pointing out that no scientist can find satisfaction in 'declaring himself to be a pure mechanism',[26] Schrodinger examines two propositions based on common experience : (i) My body functions as a pure mechanism according to the laws of Nature. (ii) Yet I know, by incontrovertible direct experience that I am directing its motion of which I foresee the effects, that may be fateful and all important, in which case I feel and take full responsibilities for them.'[27] While in the waking state we seem to determine our acts, in sleep or unconscious state human body functions although no voluntary

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24. Quoted in *The American Review* (Summer 1974) p. 52

25. Erwin Schrodinger *Mind and Matter* (Cambridge University Press. 1967) p.92

26. Ibid

27. Ibid, pp.92-93.

will is exerted for its functioning. Schrodinger's inference on these two questions shows the transformation of a physicist into a philosopher. 'The only possible inference' he says, 'from these two facts is, I think, that I (I in the widest meaning of the word that is to say, every conscious mind that has ever said or felt 'I') am the person, if any, who controls the 'motion of atoms' according to the laws of Nature.'[28]

The only support to this inference he finds in the ancient Upsanisads of India. Boldly, upholding this Upanisadic or the Vedantic philosophy before the western scientist, Schrodinger says :

From the early great Upanisads the recognition ATMAN=BRAHMAN (the personal Self called the omnipresent, all-comprehending eternal Self) was in Indian thoughts considered far from being blasphemous to represent the quintessence of deepest insight into the happenings of the world. The striving of all scholars of Vedanta was, after having learnt to pronounce with their lips, really to assimilate in their minds this grandest of all thoughts.[29]

4. *The mysterious universe*

From the early 1920s quantum physics began to impress the world with an increasing number of successes. Under its influence the theory of chemical bond was discovered. It also developed the theories of solid-state matter, metals, electrical conductivity and magnetism. Nuclear physics began. Particle physics developed. But Einstein stood stubbornly apart from quantum physics. Physicist Paul Ehrenfast said, 'We have lost our leader.'[30] From

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28. Ibid, p.93

29. Ibid

30. *The Cosmic Code,* p. 43

1927 onwards Einstein lived working on his unified field theory without any visible success and turned his attention not 'within the atoms, but outward to the stars, and beyond them to the vast drowned depths of empty space and time',[31] as Lincoln Barnett said.

However, even without quantum mechanics, the very immensity of the Universe and the startling discoveries of astrophysics compelled many physicists of this century to shift to an idealistic view of the universe. Eminent scientists like Arthur Eddington and James Jeans came forward to popularize this view among the common people who until the beginning of the 20th century had only a limited view of our universe. Jeans indicated that the probable number of stars in the universe could be something like the total number of grains of sand on all the sea-shores of the world. And our Sun, a second rate star, 'is a million times as big as the earth and 300,000 times as massive.'[32]

Astronomer Edwin Hubble of the Mount Wilson Observatory studied sample areas of space in the outer skies over a period of years and came to the conclusion that one gramme of matter per cubic centimeter of space is. 00000 00000 00000 00000 00000 00001[33]. Applied to Einstein's field equation, this figure confirms that space is curved and that the radius of this universe is 35 billion light years or 21, 00000, 00000,00000,00000, 00 miles. A sunbeam moving with the speed of 186,000 miles per second will take 200 billion terrestrial years to complete the cosmic circle.[34] Standing in reverence and awe at a tiniest corner of this universe Einstein, the erstwhile positivist admitted,

31. *The Universe and Dr. Einstein* p.35

32. C. E. M. Joad, *Philosophical Aspects of Modern Science* (London: Unwin Books, 1963) p. 42

33. *The Universe and Dr. Einstein* p.101-2

34. Ibid

The most beautiful and most profound emotion we can experience is the sensation of the mystical. It is the sower of all science... To know that what is impenetrable to us really exists, manifesting itself as the lightest wisdom and the most radiant beauty which our dull faculties can comprehend only in their most primitive forms - this knowledge this feeling is at the centre of true religiousness.

That deeply emotional conviction of the presence of a superior reasoning power which is revealed in the incomprehensible universe, form my idea of God.'[35]

Physicist John Wheeler tells us that the universe we know is '13 billion years old, 26 billion light years across, filled with galaxies that too are now estimated in billions - is but one of who knows how many likely trajectories of universes across a gigantic platform of super-space whose dimension are not three or four but infinite.'[36] Astrophysicist Fred Hoyle writes in his book *The Nature of the Universe* 'No literary imagination could have invented a story one hundred part as fantastic as the sombre facts that have been unearthed'.

Today the exploration of the mysteries of this immensely complex universe, both in the microcosm and the macrocosm, has become almost a spiritual passion with the physicists. Steven Weinberg, Nobel Physicist in 1979, expressed this very idea which may be interchanged with the language of mystics, or of tragedians like Sophocles or Shakespeare: **'The effort to understand the universe is one of the few things that lifts human life a little above the farce, and gives it some of the grace of tragedy.'** [37]

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35. Ibid, p. 113

36. Cited in Huston Smith, *The Forgottten Truth* (New York: Harper Colophone Books 1976) p. 102

37. Quoted in *The Cosmic Code*. p. 278

In its latest forms Physics today is turning into a spiritual quest consuming the entire devotion of the scientist who finds in this pursuit of pure knowledge the justification of human life. The feeling of awe and reverence in the presence of the unexplainable mystery of life and the indomitable tenacity of human aspiration towards perfection despite all failures in life - it is this contradiction that imparts a tragic sense to human existence. This tragic sense finds its most sublime expression in the speculations of some of the eminent modern physicists.

Vivekananda exposes this tragic dichotomy between the inescapable limitations of our intellects and the indomitable desire for knowledge in man, who has been struggling to explore a mysterious universe since the dawn of civilization, in the following words:

So with our intellect. In our desire to solve the mysteries of the universe, we cannot stop our questioning, we feel we must know and cannot believe that no knowledge is to be gained. A few steps and there arises the wall of beginningless and endless time which we cannot surmount, and the whole is irrevocably bound by the walls of cause and effects. We cannot go beyond them. Yet we struggle, and still have to struggle. And this is Maya.[38]

5. *The idealistic view of the universe*

The immensity of the universe inspired James Jeans to write: 'The universe can be pictured, although still very imperfectly and inadequately, as consisting of pure thought, the thought of what, for want of a wider word, we must describe of a Mathematical Thinker.' The concept of the universe as a product of pure thought has a striking resemblance to the Upanisadic view of the ultimate reality as a great Poet who conceives this universe in thought and creates it. The Mīmāṁsakas, who developed the philosophy of Vedic exegesis, held that behind

38. *Complete Works* 2 (1976) : 119

every phenomena in nature was the word and behind every word was the idea. Thought is always earlier to word, the 'word' which, as the Gospel of St. John says, was with 'God' and the word was God. Vivekananda says:

The universe is thought, and the Vedas are the words of this thought. We can create and uncreate this whole universe. Repeating the words, the unseen thought is aroused, and as a result a seen effect is produced. This is the claim of a certain sect of Karmis. They think that each one of us is a creator. Pronounce the words, the thought which corresponds will arise, and the result will become visible. 'Thought is the power of the word, the word is expression of the thought,' says Mīmāṁsakas, a Hindu philosophical sect.[39]

Wherever name is, there is form and thought. It naturally follows that if the universe is built upon the same plan as the body, the universe also must have the same divisions of form, name, and thought. The 'thought' is the finest part of the universe, the real motive power. The thought behind our body is called soul, and thought behind the universe is called God.[40]

The philosophical outcome of Jeans' idea of the 'Mysterious universe' is unmistakable. It is, writes Joad,

as if having invented a game for ourselves, and laid down its rules, we suddenly discover that the outside obeyed the very rules which we had invented...That the universe bears witness to the workings of a mind that has kinship with our own.[41]

'Religion is the science which learns the transcendental in nature through the transcendental in man,' says Vivekananda. 'We know as yet but little of man, consequently but little of the universe.'[42] Man the microcosm, says Vedanta, preserves

39. Ibid,7 p. 48

40. Ibid,4 (1978): 49

41. *Philosophical Aspects of Modern Science* p. 48

42. *Complete Works* 8 (1977) : 20-21

within him in a coiled form all the knowledge of the macrocosm, the infinitely vast cosmic universe outside.

Jeans also speculates that this four dimensional (space-time) universe in all probability contains more dimensions which are not perceptible to our senses. He compares scientists to the 'blind worms' which know only the two-dimensional surface of the earth, and are unconscious of the other two dimensions. Jeans also suggests, the four-dimensional space-time continuum which mathematical physics studies may be merely a phenomenal projection of a reality which occupies more than four dimensions; this reality is identified with God's mind.[43]

This suggestion of Jeans is one of the basic principles of Vedantic epistemology. Vedanta believes that in altered states of consciousness we become aware of a 'separate reality' as Carlos Castaneda calls it in his book of the same title. 'The whole universe is but one,' says Vivekananda, '..which through the senses we see as matter, through the intellect as souls; and through the spirit as God.'[44]

While positivism believes only in the sensory verification of matter, Idealism speculates on the reality of the ideas behind matter. In the latter part of his life Heisenberg was deeply influenced by Platonic Idealism. He wrote, 'The elementary particles can be compared with regular bodies in Plato's *Timaeus.* The original models determined all subsequent developments. It is these ideas that help us to create our concept of matter.'[45] In the light of quantum physics 'we create', writes M. Talbot, 'for ourselves a word-built world. We lock ourselves into the world to the extent that our thinking proceeds to become

43. Cited *Philosophical Aspects of Modern Science* p. 46

44. *Complete Works* 2: 252-53

45. *Heisenberg* p. 122

dependent upon semantics. But we should not confuse our word-built reality with what is actually out there'.[46]

Vivekananda clarifies this idealistic view of the universe as something in the Hindu way of thinking. He says, 'When the Hindus would express, "I saw a thing", they say "I saw a word meaning *(padartha)*." "Even this universe is a word meaning."'[47] In Sanskirt **pada** means word and **artha** means meaning. Hindus call any phenomenal reality as **padartha**.

To his western disciple Sister Nivedita, Vivekananda said, 'Orthodox Hinduism makes *śruti,* the sound, everything. The thing is but a feeble manifestation of the pre-existing and eternal idea.[48] Sister Nivedita found in the above mentioned words of her master a more rational exposition of Plato's idealism. She writes, 'Thus the Greek philosophy of Plato is included within the Hindu philosophy of Mīmāṁsakas, and a doctrine (of platonic idealism) that sounds merely empiric on the lips of Europe, finds reason and necessity, on those of India'.[49] Nivedita wrote this in the first decade of this century, long before Heisenberg declared in his celebrated World Science Congress speech, delivered at Washington on the 500th anniversary of Copernicus in 1973, that physicists will have to turn to Plato's ideas for explaining physical reality.

6. *Unity - the goal of physics and Vedanta*

Heisenberg's teacher Sommerfeld wrote to Einstein, 'I can only promote quantum techniques. You must promote the philosophy.[50]

46. *Mysticism and New Physics* p. 8

47. *Complete Works* 7; 82

48. *Complete Works Sister Nivedita* (Calcutta : Sister Nivedita Girls School. 1967) 1: 146

49. Ibid

50. *Heisenberg* p. 18

Yet Einstein did not formulate any philosophy stuff in what was written and spoken in later years by his great although there is a lot of philosophical of physics as such, intuitive mind. But physics today is relating itself increasingly to philosophy and drawing closer to Vedanta philosophy. Heisenberg himself hinted at this connection. **'The great scientific contribution in theoretical physics that has come from Japan since the last war may be an indication of a certain tradition of the Far East and the philosophical substance of quantum theory.'**[51]

Metaphysical questions are increasingly drawing the attention of the leading theoretical physicists of 1890. In an article on a recent interview with the celebrated black hole physicist Stephen Hawking of Cambridge, the writer Michael Harwood states:

> **'The theoretical physicist, although he deals in such arcane, modern concepts as curved time and space, is part of a philosophical and spiritual tradition older than recorded history. He seeks to know not just life as he experiences it but how the hidden parts of the universe work and fit together.**
>
> **That isolates the theoretical physicist from the intellectual mainstream, yet the rewards may be cosmic in scope, for the physicist seeks grand answers that will effect the lives of everyone - on spiritual and practical - levels of ever after.'**[52]

In another recent interview with physicist John A. Wheeler whose concept of 'Superspace' and 'Many-worlds interpretation' of quantum theory have considerably influenced the world of modern physics for the last thirty years, the writer Timothy Ferris mentions how Wheeler was dreaming of a drastic simplification about our knowledge of the universe. Sitting in his room and

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51. Fritjof Capra, *The Tao of Physics* (Berkeley:Shambhala Publication, 1975) p. 18

52. *The New York Times Magazine*,. 23rd June 1983. p. 16

watching the river turning gold with rays of sunset, Wheeler said quietly,

We find the world strange, but what's strange is us. It seems to me that we don't yet read the message properly, but in time to come, we will see it in some single, simple sentence. As we say that sentence to each other we'll say, 'Oh, how beautiful.' How could we have missed it, all that time?[53]

Vivekananda predicted that modern science would touch its final destination as soon as it reached 'Unity' - that is, the knowledge that the microcosm contains in it the entire potentialities of the macrocosm. Wheeler's dream of a single, simple sentence explaining the strange, universe reminds us of the simple but profoundly powerful lines like, *tat twam asi* (Thou art That) or *aham brahmasmi* (I am Brahman or Existence-Knowledge - Bliss Absolute). Both the sentences contain the cardinal principle of Vedanta - the microcosm contains the macrocosm.

Timothy Ferris writes, 'Physicists seeking a unified theory of nature's forces are finding that the history and the fate of the universe is written in every atom.'[54]

We are here listening to an echo of what Vivekananda told his western audience more than eighty years ago:

Though an atom is invisible, unthinkable, yet in it are the whole power and potency of the universe. That is exactly what the Vedantist says of Atman.[55]

The world is homogeneous, and modern science shows beyond doubt that each atom is composed of the same material as the whole universe... Man is the most representative being in the universe, the microcosm, a small universe in himself.[56]

53. Ibid, 26th September 1982, p. 70

54. Ibid, p.87

55. *Complete Works* 7; 50

56. *Complete Works* 4: 49

This also reminds us of Vivekananda's famous definition of God and man. 'Man', he said, 'is an infinite circle whose circumference is nowhere, but whose centre is everywhere.'[57]

Nearly half a century later Schrodinger echoes these very ideas in his Cambridge lectures on modern physics. The principle of the identification of macrocosm and microcosm, the basic unity of man and the ultimate reality, as we see, is common both to modern physics and the ancient Vedanta philosophy. On the contrary it is not only alien but blasphemous in the Judeo Christian tradition. **'In Christian terminology to say', writes Schrodinger, ' "Hence I am God Almighty" sounds both blasphemous and lunatic. But please disregard these connotations for the moment and consider the above reference (that the individual is identical with the Cosmic I or Atman = Brahman) is not the closest a biologist can get to proving God and immortality at a stroke'.**[58]

57. Ibid 2 : 33

58. *Mind and Matter* p. 93

7

VEDIC COSMOLOGY AND MODERN ASTROPHYSICS

The universe had a beginning

RECENT developments in astrophysics seem to be moving closer to ancient Indian cosmology. The age-old Vedic conception of the universe as passing through cycles of creation *(sristi)*, sustenance *(sthiti)*, and dissolution *(pralaya)* was looked down upon as mythological by modern science until the 1920s. But Swami Vivekananda, even at the end of the nineteenth century, spoke about the cosmological speculations of Orientals: '...you will find how wonderfully they are in accordance with the latest discoveries of modern science; and where there is disharmony, you will find it is modern science which lacks and not they'.[1]

During the nineteenth century the Western view of the universe was considerably influenced by dogmatic theology which held that the world was created in 4004 B.C. one Friday afternoon. To Californians Vivekananda rather humorously pointed out, 'Remember, this world is very old; it was not created only two or three thousand years ago. It is taught here in the West that society began eighteen hundred years ago, with the New Testament. Before that there was no society. That may be true with regard to the West, but it is not true as regards the whole

1. *The Complete Works of Swami Vivekananda* (Calcutta: Advaita Ashrama. 1976) vol. 2, pp.432-33

world.'[2] But by 1900 western science had already started racing past dogmatic theology and rationalists had begun to express their views freely. Had Vivekananda preached the same Vedic ideas in the West only fifty years earlier, he would have been, as Ingersoll said to him, 'hanged .. burnt alive or ... stoned out of the villages'.[3]

Even after the immensity of cosmogonic time came to be recognized by Western science, the concept of a static and eternal universe persisted in the common thinking of Western scientists up to the 1920s. Even Einstein thought of this universe as a 'closed universe'.[4] With his prodigious intellect Einstein calculated the radius of this static universe - about 35 billion light years.[5] He even developed the concept of a cosmological constant which would make the universe remain constant.

But the first blow to this concept of a closed universe came in the early 1920s when Edwin Hubble and Humason, for the first time, discovered that the spectral lines of distant galaxies show a shift towards the red. They theorized that this 'red shift' meant that the distant galaxies were receding faster than those galaxies which are nearer to our own system. According to their calculation the galaxy in hydra cluster is moving away with the speed of 61000 kms per second from us. This epoch-making discovery made astrophysicists conceive of the universe as undergoing expansion after a primeval exposition which they called the 'Big Bang'.[6]

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2. Ibid, p.27
3. Ibid
4. Nigel Calder, *Einstein's Universe* (New York: The Viking Press, 1979) p.131
5. Lincoln Barnett, *The Universe and Dr. Einstein* (London: Comet Books/ Collins, 1956) p.101
6. Dr. J.V. Narlikar, 'The Exploding Universe', *Illustrated Weekly of India.* Nov.6-12, 1983. p.8.

In 1932 Russian physicist Alexander Friedman constructed the model of an expanding universe which was different from Einstein's model of a static universe.[7] Another Nobel physicist George Gamow of George Washington University, working on the Big Bang theory calculated that after the Big Bang the universe will continue to expand for about two billion years.[8] California physicist R.C. Tolman proceeded further. The cosmic expansion according to him is a temporary phenomenon which will be followed in some distant time by a period of contraction. 'The universe in this picture', says Lincoln Barnett, 'is like a balloon in which cycles of expansion and contraction succeed each other through eternity.'[9]

Apart from these ideas of the Big Bang, the universe, according to the Second Law of Thermodynamics, is progressing towards a 'heat death' when all the galaxies and stars will have given away their energy in the form of heat and radiation and the whole universe will have attained one uniform temperature. What is this heat death? It has some striking resemblance to the Indian concept of 'Pralaya' or dissolution. Writes Lincoln Barnett of this state with a rare clarity:

...All space will be at the same temperature. No energy can be used because all of it will be uniformly distributed through the cosmos. There will be no light, no life, no warmth - nothing but perpetual and irrevocable stagnation. Time itself will come to an end. For entropy is the measure of the randomness. When all system and order in the universe have vanished, when randomness is at its maximum, and entropy cannot be increased, when there no longer is any sequence

7. Ibid

8. The *Universe and Dr. Einstein,* p.106

9. Ibid

of cause and effect - in short, when the universe has run down, there will be no direction to time, there will be no time. And there is no way of avoiding this destiny...[10]

'The important philosophical corollary' and 'the inescapable inference' from this running down of the universe to a state beyond time and energy flow is, writes Lincoln Barnett, 'that everything had a beginning'.[11]

In the early 1950s George Gamow and his colleagues working on the Big Bang theory predicted that there must be existing some kind of microwave radiation in the whole universe as a relic of the Big Bang. Though several scientists at first doubted the existence of such a radiation, two physicists of Bell Telephone Laboratory, New Jersey, Arno Penzias and Robert Wilson, discovered it in 1965 by sheer accident. While working on a big horn-shaped antenna they received a strange kind of residual radiation coming from all directions. In the beginning this seemed to be a cosmic noise which they could not explain. But two other scientists, Robert Dick and Jim Peebles of Princeton University, identified this radiation as the relic of the first Big Bang. Penzias and Wilson found that empty space in the entire universe is not cold to 0° but has got a temperature of 3° Kelvin which is the residual effect of the radiation of the original Big Bang. Thirteen years later, during which period their discovery was subjected to thorough scrutiny, they were awarded Nobel Prize for this discovery which established the Big Bang theory almost beyond a doubt.[12]

What is this 3° Kelvin radiation? In the Kelvin scale 0° equals minus 273.16° celsius. Scientists have calculated that at the first

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10. ibid, p.107
11. Ibid, p.110
12. *'The Exploding Universe'*. p.10

hundredth of a second after the Big Bang the temperature of the universe was one hundred billion Kelvin. After the first tenth of a second, the universe cooled down to ten billion Kelvin. After 14 second, it came down to about one billion degree Kelvin.[13] After a billion years eventually the universe cooled sufficiently to allow the particles to come together as atoms of hydrogen and helium - the raw material of the universe. 'A great flash of light occurred as the atoms formed, and that was the possible origin of 3°K radio energy', writes Nigel Calder.[14] The universe today, according to the latest calculations looks indeed like the relics of a huge explosion that took place in the remote past.

That our universe had a beginning in some remote past is today once again established by the startling discovery that protons also decay. Proton which is the more stable particle in the nucleus of an atom, was at first believed to live for ever. In the late 1960s Soviet physicist Andrei Sakharov predicted that protons like other unstable nuclear particles also decay; this proton decay means that the universe is slowly disappearing which obviously presupposes that the universe had a beginning. The first proton decay experiment to report positive result was made in the Kolar Gold Field mines in India by scientists from the Tata Institute of Fundamental Research (TIFR), Bombay, and their Japanese colleagues. A proton, according to the latest calculations, is supposed to have a 50-50 chance of decaying in 10^{32} years or, in other words, protons have a half-life of 10^{32} years. Scientists working in a tunnel beneath the Mont Blanc also claim to have obtained evidence of proton decay.

The discoveries leading to the confirmation of the fact that the universe had a beginning in some remote Big Bang, and will

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13. Heinz Pagels, *The Cosmic Code* (New York: Bantam Books, 1983) pp.281-82.

14. *Einstein's Universe,* p.122

have an eventual 'collapse' in a 'Big Crunch' in some remote future, made Einstein withdraw his concept of the 'cosmological constant'. He even bitterly regretted having invented it in order to maintain his theory of a static universe.[15]

How was the Beginning?

How was the beginning of the universe? The latest discoveries, writes Nigel Calder, 'permit most theorists to agree upon the course of events during the Big Bang and to describe them with remarkable assurance.'[16] This is what the physicists have traced as the early stages of the universe after the Big Bang :

1. One billion years old - we watch the galaxies being born alone with blue-white infant stars.
2. One hundred million years old - A dark sea of hydrogen and helium, a few protogalaxies and a few islands of new born stars.
3. One hundred thousand years old - The temperature of the universe is 4500° Kelvin, nearly the temperature of the sun. Darkness is replaced by light.
4. 2 minutes 15 seconds old - The universe is dense as rock, in great heat it resembles rock being vaporized in a nuclear explosion. At this stage helium is being forged.
5. Still earlier in time - Atoms cannot be formed. No nucleus can survive. Heavy subatomic particles like protons and neutrons and light ones like electrons and neutrinos are moving about restless and unsettled.
6. Still deeper in time - Even heavier subatomic particles cannot survive: their constituents like quark, leptons and photons, all remain as if in a boiling soup.
7. A still earlier stage - The universe moves slowly back toward the stage of one *Force* - the electro-weak force is now breaking

15. Ibid, pp.147, 123

16. Ibid, p.121

into electro-magnetic and weak-interaction forces. The universe is now a *million, million times denser* than the nucleus of an atom. And the radius of the universe is smaller than the orbit of the earth around the sun.

8. Far, far deeper in time, 10^{-35} second after the Big Bang - The electronuclear force is breaking into electro-weak and strong interaction forces. The universe is a homogeneous pool of matter or *akasa* as Vivekananda put it.

9. Still deeper in time - The universe is now 10^{-43} second old. How short is this time? If 10^{-43} second is one second, then one flash of a camera will take 20 billion years (or 20 thousand million years). It is at this stage that from the Cosmic Force the first two force in nature, Gravity and Electronuclear forces are being born. This is the stage, though infinitesimally small in duration, after the Big Bang when the Monotheistic Rule ends.[17]

The death of stars and blackholes :

The birth of our universe from a highly dense and dark state of existence has been a matter of great interest to scientists for quite a long time. Nearly two centuries ago an English astronomer John Michell pointed out that a heavy star, sufficiently compact, could even compel particles to gravitate into it. In the early part of this century Einstein predicted that light can be deflected by a strong gravitational field. Theoretical physicists have since then been trying to evolve the idea of a super-dense star capable of swallowing everything around it, even light. In 1968 American physicist John A. Wheeler applied the term 'blackhole' to such a self-hiding body.[18]

Today the study of the gravitational collapse of stars into blackholes is a passion with many physicists. Dr. S. Chandrasekhar, who received Nobel Prize in 1983 for his contribution to the

17. Adapted from *The New York Times Magazine*, 26 Sept. 1982, p.68-69

18. Ibid, 23 January, 1983. p.54

knowledge of the collapse and death of stars, has shown that stars collapse as a result of their own gravitational force. The collapse, in its turn, triggers thermonuclear explosion inside them. In that process hydrogen is converted into helium. In case of heavy stars, even helium is converted into carbon and oxygen and eventually into iron, an element which releases no energy, and the nuclear alchemy stops there.

What happens to a star which has exhausted all its nuclear fuel? Will such a star be able to keep up its equilibrium against the powerfully attracting force of gravity? The existence of the stars called 'white dwarfs', which are visibly faint but highly dense and compact, gives us the answer, 'yes'. But how? 'The answer lies', says astrophysicist Jayant Narlikar, 'in the exclusion principle (of Pauli) which forbids two identical particles like the electrons to be present together. The tendency of a star to attract means more and more of particles in the same small volume. The exclusion principle puts a limit on how closely we can pack the matter together. Out of such restrictions a new pressure emerges which opposes further contraction.'[19] This anti-gravitational force maintains equilibrium in the white dwarf stage of a collapsing star. If the mass of the collapsing star is heavier than 1.44 times the mass of the sun (this is the celebrated Chandrasekhar's limit), then it has no defense against gravitational pressure. In that case matter is ultimately squeezed into an infinitely dense mass giving rise to a blackhole. Jayant Narlikar writes 'Thus all white dwarfs must respect this mass limit in order to survive.' According to Dr. Chandrasekhar's calculations, if the earth were to shrink to a radius of 2.5 kms it would become such a blackhole, permitting no light to escape from it.

If Dr. Chandrasekhar had shown how blackholes could be formed, the celebrated Cambridge physicist Stephen Hawking has

19. 'The Exploding Universe'. p.13

made significant theoretical contribution to our knowledge of the mode of working and properties of the blackhole. Hawking's work shows that some blackholes may be theoretically visible as they emit particles from the region around the entrance. One could even see a blackhole exploding and thus learn some thing about the Big Bang.[20]

Hawking took his cue from the theoretical work of physicist Roger Penrose of Oxford who first showed contrary to the belief of Newtonian physicists, that the collapse of stars could reach a state of 'infinite density' which could in fact be compared to the 'proverbial head of a pin'. This is what cosmologists call the 'state of singularity' or the 'boundary conditions' and this is what preceded the beginning of the universe in the Big Bang. By 'singularity' physicists mean an infinitely small space of time. In fact this is 'a theoretical edge of "space and time" ...' as Michael Harwood writes. 'Towards that edge, that minuscule point, races at unimaginable speed all the matter sucked into the blackhole, all the matter of a star or of a universe, to be crushed into a region of infinite density from which nothing escapes and where none of the known laws of physics apply.' Penrose's calculations 'guarantee that despite irregularities a singularity can occur.'[21]

According to the law of gravitation, a blackhole will swallow anything that happens to be within its periphery of attraction, and naturally it will grow more in mass and size. But Hawking, again, theoretically discovered something quite to the contrary. By taking the help of Penrose's work and developing on the work of the Russian physicist Yakov B. Zeldovich, Hawking discovered by applying quantum mechanics to the blackholes that blackholes could also shrink. Michael Harwood, writing on Hawking, says,

20. *The New York Times Magazine,* 23, January, 1983, p.56

21. Ibid, p.59

'The results surprised and dismayed Hawking ... In other words, blackholes could lose mass and diminish in size. Eventually they could even evaporate.'[22] Later on Hawking also discovered that blackholes cannot reach zero volume, as Heisenberg's Uncertainty Principle does not allow anything to reach the Zero volume. At infinite density, a blackhole, will explode to new creation.

Hawking believes that in these two contradictory findings we see only 'two different aspects of a thermodynamic behaviour of blackholes...They were the same thing, in fact, in different regimes.'[23] A Vedic seer would find no contradiction in the growth of blackholes into new creation through Big Bang or the shrinking of blackhole into virtual nothingness. The former one is creation or *srsti* from *avyakta* or the Undifferentiated, and the latter one is the dissolution or *pralaya* of the universe into the same. Hawking's greatness is that he mostly worked, as the mystic Vedic seers did, through intuition. Harvard physicist William Press writes that Hawking works by 'key overview ideas - great organizational principles'. And these overview ideas come to him, Michael Harwood says, as **'spiritual revelations'**, and make him 'one of the greatest physicists of our age.'[24] The Uncertainty Principle says one can know either the position or the velocity of an electron but never both. The uncertainty Hawking faced in the study of blackholes was even worse. 'There was no way to predict either the position or the speed of the particles emitted by a blackhole'. Hawking points to this deeper uncertainty about the knowledge of blackholes by saying 'that God not only plays dice but also sometimes throws them where they cannot be seen.'[25]

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22. Ibid, p.64
23. Ibid
24. Ibid, p.53
25. Ibid, p.56

Vivekananda, however, offers two Vedic theories regarding the creation and dissolution of the Universe. According to the first theory, the whole of the universe comes into creation and goes to dissolution at one and the same time. According to the second theory, while in one part of the universe the act of creation goes on, in the other part the act of dissolution may also go on. This is somewhat like foam bubbles appearing in one part of a gigantic wave and disappearing in another part of it. The second theory which obviously is supported by today's physics is favoured by Vivekananda. He explains the Vedic idea:

Some of these philosophers hold that the whole universe quiets down for a period. Others hold that this quieting down applies only to systems; that is to say, that while our system here, this solar system, will quiet down and go back into the undifferentiated state, millions of other systems will go the other way, and will project outwards. I should rather favour the second opinion, that this quieting down is not simultaneous over the whole of the universe, and that in different parts different things go on. But the principle remains the same, that all we see - that is, nature herself - is progressing in successive rises and falls. The one stage, falling down, going back to balance, the perfect equilibrium, is called Pralaya, the end of a cycle. The projection and the Pralaya of the universe have been compared by theistical writers in India to the outbreathing and inbreathing of God: God, as it were, breathes out the universe, and it comes into Him again...[26]

Who made the Big Bang?

The concept that this universe did one day spring out of an infinitesimally small volume or zero volume is slowly being accepted. Dr. Hawking says: 'We are not sure whether it came

26. *Complete Works,* 2:434

from absolute zero size but we know that it must have been very small indeed'.[27]

J.V. Narlikar, who is one of the staunch adherents of the Steady-State theory which is opposed to the Big Bang theory, makes a startling statement regarding his own calculations of the origin of the universe. He writes: 'The odds that the universe emerged from a state of zero volume turned out to be zero'.[28]

Aristotle believed in the existence of a static universe. His Christian interpreter Thomas Aquinas disagreed with him and said, though centuries before today's discoveries, that the world was a *creatio ex-nihilo*, a creation out of nothing. Where did the universe come from ? Two American cosmologists Allan H. Guth of MIT and J. Richard Gott of Princeton are trying to offer two models of the creation of the universe both of which show that the universe had in fact originated from nothing. Guth offers what is known as the inflationary model. 'The inflationary model', he writes, 'is an attempt to build the universe from almost nothing.'[29] Guth continues: 'It is often said that there is no such thing as free lunch, it now appears possible that the universe is a free lunch.' We remember Sri Ramakrishna's famous simile about the nature of personality. It is like an onion. Peel it off layer by layer and in the end there is 'nothing' left. 'Pure Being and nothing are the same', said Hegel.[30]

Einstein believed that 'the grand unified theory' will touch the 'grand aim of science' - which is 'to cover the greatest number of empirical facts by logical deduction from the smallest

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27. *The New York Times Magazine,* 23 January, 1983, p.54
28. 'The Exploding Universe', p.12
29. *The New York Times Magazine,* 26 September, 1982, p.69
30. *The Universe and Dr. Einstein,* p.118

possible number of hypotheses or axioms.'[31] The Nobel prize winning discovery of one electro-weak force from which electromagnetic and weak interaction forces were derived, made by Steven Weinberg, Sheldon Glashaw and Abdus Salam, point to the same direction - the search for the One Force behind many Forces in the universe.

Vivekananda's whole effort of preaching Vedanta philosophy in the West was aimed at establishing the Pure Being, the Sat, as the basis of Cosmic existence.

Through the duality of Samkhya to the One of Vedanta

When Swami Vivekananda went to explain the Vedanta philosophy to the Harvard Graduate Philosophical Society on 25 March 1896, he knew fully well that he was speaking to some of the front-rank intellectuals of America. After telling them about the three principal schools of Vedanta philosophy, namely, the dualistic, the non-dualistic and the qualified non-dualistic, Vivekananda continued: '...these different Vedanta systems have one psychology, and that is the psychology of the Samkhya system'.[32] Swamiji then introduced the theory of cycles according to which the universe passes through evolution and involution alternately. Only the followers of Saṁkarācārya, the monists, he said, consider the process of creation and dissolution as not real but an 'apparent manifestation' or *vivarta* according to the philosophy of Vivartavāda.

Vivekananda knew only too well that not only the common people but even the majority of the scientists trained in the western tradition were dualists. The Cartesian division of mind and matter, God and universe is too deeply rooted in the western thinking to be overthrown overnight. Even today, nearly 100

31. Ibid, p.117

32. *Complete Works,* 2:359

years after Vivekananda's preaching of Vedanta, except a few physicists like Schrodinger, most scientists do not accept that monistic Vedanta shows the path to the real Truth and that Cartesian dualism is ultimately untenable. It was for this reason that Swamiji began his lecture on Vedanta philosophy by choosing the path of least resistance - the path of Samkhya which considers the universe to be real and produced by interaction of the fundamental factors called Prāna (Force) and Ākāsa (matter). The failure of the American scientist Nicholas Tesla to mathematically prove that mass could be equated to 'potential energy'[33] must have frustrated, at least temporarily, Vivekananda's dream of establishing Advaita Vedanta as the basis of modern science. Had Vivekananda gone to the West after Einstein, who showed the equivalence of mass and energy and the unity of space-time continuum, the establishment of Vedantic monism would have been definitely easier for him. But Vivekananda was unrelenting. He gave the idea of Advaita Vedanta without fear, and prophetically asserted in 1896 in his celebrated London speech 'The Absolute and the Manifestation' that Advaita Vedanta would be the only rational religion of Western intellectuals in the years to come.[34]

Comparing Samkhya and Vedanta philosophies, Vivekananda says: 'The idea of the Advaitists is to generalise the whole universe into one...that it is One Being manifesting itself in all these various forms. They admit that what the Śaṁkhya calls Nature exists, but say that nature is God.'[35] But Vedanta takes one step further and 'believes that there is one soul which appears as many; and we build on the Śaṁkhya analysis', says Vivekananda. By 'Samkhya analysis' Swamiji evidently meant

33. Cf *Complete Works* (1973) 5:10

34. Ibid, 2:139

35. Ibid, (1977) 1:362

the Samkhyan principle of *sat-kārya vāda* according to which 'the effect exists in the cause'. As Swamiji repeatedly showed, what this principle means is that the universe does not require an explanation from outside. God is the self-evolving cause of the universe, which is not different from Him. In western thought this principle is known as 'naturalism' which is the foundation of science and rationalism.

Vivekananda, however, clarifies that the conversion of God into nature is caused by *deśa, kāla* and *nimitta* - space, time and causation - and this conversion, according to the monism of Samkara, is not real but apparent, since the immutable one cannot become mutable. According to the Advaitsts proper, the followers of Śaṁkarācārya, '...the whole universe is the *apparent* evolution of God. God is the material cause of this universe, but not really, only apparently. The celebrated illustration used is that of the rope and the snake, where the rope appeared to be the snake, but was not really so.'[36]

Vivekananda did not reject the world. He did not waste his time and energy to prove the illusoriness of the world. Like that of his master Sir Ramakrishna, his whole effort was directed to the establishment of the truth that whatever exists is only Brahman or God. That is why he referred to the first of the Upanisads, Isopanisad by the title 'God in everything'. He could have said *God only is; nothing else is.* He knew through his own mystic experience the truth of non-duality, but for the sake of those who have not reached that mystic height, Vivekananda came down to the dualistic plane accepting this universe as real. Then by showing through analysis that the apparently real universe or Prakrti of Samkhya ultimately culminates in the all-pervading Brahman of the Vedanta philosophy, he brought home to the people the truth of non-duality. In all this he followed

36. Ibid, p.363

years ... enunciated: 'man proceeds not from
phy... ...er truth to greater truth.'

m... ... the many to the One Reality, from
...a, Swamiji was echoing the voice of his
...nakrishna :

> **...My Divine Mother is none other than the Absolute. She ... the same time the One and the Many, and beyond the One and the Many...**
>
> **...My Divine Mother is the primordial Divine Energy. She is omnipresent. She is both the outside and the inside of visible phenomena. She is the parent of the world, and the world carries Her in its heart. She is the Spider and the world is the web She has spun. The Spider draws the thread out of Herself and then winds it round Herself. My Mother is at the same time the container and the contained. She is the shell, but She is also the Kernel.**[37]

And like his master Vivekananda 'believes in nothing that he has not first realized through his entire being'. That is why his 'thought has the breath of life'. That is why these ideas have 'come to fruition', as Romain Rolland says of Ramakrishna, 'in an orchard of 'realizations", no longer abstract and isolated, but clearly defined and having a practical bearing on everyday life for the satisfaction of the hunger of men...And he will share the food of immortality in a Lord's Supper, not with twelve apostles, but with all starving souls - with the universe.'[38]

Ancient Vedic vision of the origin and dissolution of the universe

Swami Vivekananda was very fond of the great Rg-Vedic Hymn of Creation known as the *Nasadiya-suktam*. He saw in it the ancient sages' vision of the universe as it existed before

37. Romain Rolland, *The Life of Ramakrishna* (Calcutta: Advaita Ashrama, 1979), pp.67-68.

38. Ibid, pp.70-71.

its creation. He translated the whole hymn, the first three stanzas of which are given below :

Existence was not then, nor non-existence,
The world was not, the sky beyond was neither.
What covered the mist? Of whom was that?
What was in the depths of darkness thick?

Death was not then, nor immortality,
The night was neither separate from day,
But motionless did *That* vibrate
Alone, with Its own glory one -
Beyond *That* nothing did exist.

At first in darkness hidden darkness lay,
Undistinguished as one mass of water,
Then *That* which lay in void thus covered
A glory did put forth by *Tapah*![39]

The second verse of the Nāsadīya Sūkta reads : Anidavātam Swadhayā Tadēkam Tasmāt dhyānan Na prah Kim cha nāsa. - That one without vibration began to vibrate by its own power, other than that there was nothing beyond.

Interpreting these stanzas Vivekananda says:

This Prāna existed then, but there was no motion in it; Anidavatam means 'existed without vibration'. Vibration had stopped. Then when the Kalpa begins, after an immense interval, the Anidavatam commences to vibrate, and blow after blow is given by Prāna to Akāsha. The atoms become condensed, and as they are condensed different elements are formed.[40]

We should not forget that Vivekananda was giving these teachings to the western rationalists in the 1890s, nearly a century

39. *Complete Works,* (1978) 6:178

40. Ibid, 2:435

before the concept of Blackhole and Big Bang were developed by scientists.

Sri Ramakrishna used to say that Brahman and Sakti are one. The snake which remains motionless is the same even when it undulates. The sea with or without waves is the same. The *Muṇḍaka Upanisad* says, 'Just as a spider projects its own web and then reabsorbs it into its own body, so also that One reality projects this varied universe and then absorbs it back into itself.'[41] The *Iśa Upanisad* says in the same vein: 'The one ultimate Reality is the state of absolute non-vibration. At the same time it covers everything faster than the speed of mind.'[42] The same Upanisad further states: 'It vibrates and it vibrates not'.[43] The *Kaṭhopaniṣad says:* 'Whatever we see in this universe is due to the vibration of the *prāṇa.*'[44] The *Bṛhadāraṇyaka Upanisad* says: 'There was nothing whatsoever in the beginning. It was covered only by death.'[45]

One might ask how the Vedic sages could know of the nature of the universe at the time of the origin when they themselves did not exist. They discovered cosmological truths not through empirical observation but through intuitive insight gained in *Samādhi*. Samādhi is a process of withdrawing the intellect into pure consciousness. In other words, *Samādhi* is the reversal of creation, a return to the primordial uncreated state. In this return journey (conducted in the depths of consciousness) the illumined seer discovers the stages through which the external universe passed during creation. Swami Vivekananda was himself such

41. *Mundaka Upanisad*, 1.1.7
42. *Isa Upanisad*, 4
43. Ibid, 5
44. *Katha Upanisad*, 2.3.2
45. *Brhadaranyaka Upanisad*, 1.2.1

an illumined sage. In his beautiful 'Hymn of Samādhi' Swamiji gives us a glimpse into the experience of the primordial state of Reality.

Void merged into void - beyond speech and mind! Whose heart understands, he verily does.

What the Vedic sages discovered through mystic intuition. modern scientists are confirming with the help of sophisticated instruments. Amaury De Reincourt writes, 'The cardinal fact is that contemporary physics finds a remarkable echo in Eastern, and not Western metaphysics; and that one of the prime elements of this conjunction is the monistic, and not monotheistic, vision of underlying reality.'[46] Reincourt is here alluding to the Judeo-Christian view of the creation of the universe by a personal God. Today's leading astrophysicist Fred Hoyle feels that a 'dynamic evolution would be far more in keeping with the greatness of the universe...than the static picture offered by formal religion'. What orthodox Christian theory offered him, says Fred Hoyle, was an '...eternity of Frustration'.[47] Arthur Eddington said the 'stuff of the world is mind stuff'. James Jeans claimed, 'The universe begins to look more like a great thought than a great machine'. Even Einstein who unto the end tried to cling to the physical reality of the universe admitted: 'It seems to me that science not only purifies the religious impulse of the dross of anthropomorphism but also contributes to a religious spiritualiation of our understanding of life.' He became 'at heart an Eastern monist, as most scientists who are religiously inclined.'[48] 'Great truths are simple because they are of universal application,' said Swamiji.

46. Amaury De Reincourt *The Eye of Shiva* (New York: William Morrow & Co., 1981) p.171

47. Quoted in Ibid.

48. Ibid

Physical sciences cannot enter beyond what Hawking calls the 'boundary conditions' or what Roger Penrose calls the 'point of singularity' or 'the event horizon' of a Blackhole. Only mysticism can. A true understanding of the beginning of the universe in the undivided and all-pervading Consciousness, the *akhanda, cit,* which is the eternal substratum of this universe, can only be gained in the intuitive, mystic and spiritual way and never through the purely physical process of enquiry. Amaury De Reincourt says,

This void is not emptiness; far from it; it is indeed the creative potentiality, one which can presumably be experienced by mystical insight although science cannot penetrate beyond the ultimate barrier. The mystical emphasis is always put on the ultimate non-reality of the material world and on the all-pervading reality of unindividualized consciousness (such as is postulated by the logical mind of Erwin Schrodinger) which underlies all physical appearances - but physical science can only stand on the threshold of this 'otherwise' or 'beyond' of the visible universe.[49]

Reincourt concludes with a parting shot, 'Can the data of mystical insight and that of the sciences of nature converge at some point?' It can. And the basis of that meeting will be Advaita, monistic Vedanta, as interpreted in modern times by Swami Viveakananda.

49. Ibid. pp.172-73

EPILOGUE

SIXTEEN years ago when *Modern Physics and Vedanta* was published in 1986, the chairman of India's Atomic Energy Commission, Dr. Raja Ramanna wrote in the foreword to the small book.

> **Swami Vivekananda insisted that Vedantic thought was not inconsistent with science and the two should go hand in hand. Swami Vivekananda belonged to the last century and since then science and scientific thoughts have progressed enormously and taken very different directions. The discovery of quantum mechanics and relativity have shaken the very foundations of epistemology. In spite of these violent changes it is only Vedanta which seems to be in a position to absorb the tremendous impact of the new science. I believe it (this book) is of great significance to the development of philosophy suitable for the modern world.**

Today after sixteen years physics has advanced much more, but with each step of advancement it has approached nearer and nearer to the ancient truths discovered by the seers of Vedanta. Last 50 years witnessed a physics revolution in whose latest phase, a group of physicists is seeking to shift the foundation of physics from matter to non-matter. This epilogue is an attempt to trace this revolution turning towards a historic shift of physics towards Vedantic metaphysics.

Physics reveals an universe beyond Sense-perception:

Relativity, Quantum mechanics, Particle physics, and Astrophysics, have opened an universe where our ordinary sense perception fails to work, and where only subtlest mathematics based on pure intuition can enter. Einstein's discovered that the speed of light (c) is the only constant in this relative and changing universe. Max Planck's discovery of Planck's constant (6.62 x 10^{-34} Js) is a wonder in itself. It is this constant which helps us to enter the microcosmic universe where the standard radius of the electron is 10^{-13} cm, and where sub-nuclear particles live only for a few particle seconds before changing into another type of sub-nuclear particle (one particle second is 10^{-23} second). It is on Planck's constant that Heinsberg's epoch-making equation of Uncertainty Principle ($\Delta Q \times \Delta P \geqslant h$), stands as a light house in this micro-world of quantum mechanics. The three constants in physics - C (Speed of light), H (Planck's) constant, G (gravitational force) gave us the measurement of the smallest length (Planck length: $\sqrt{GH/c^3}$ or 10^{-35} meters) and the smallest time (Planck's time: $\sqrt{Gh/C^5}$ or 10^{-43} second).[1] The fundamental minimal energies are multiples of what is known as the Planck energy. The Planck's mass is ten billion billion times that of a proton. It's about equal to the mass of a grain of dust or a collection of a million average bacteria.[2]

Astrophysics and Relativity have exposed an universe much vaster than we can imagine. It is now calculated as 15 billion years old. According Einstein's field equation its radius is 35 billion light-years.[3] According to John A. Wheeler our universe is filled with billions of galaxies spread over a "gigantic platform

1. Brian Greene: *The Elegant Universe:* (Vintage Book, USA. 2000) P.130, Paul Marshall: *The Living Mirror* (Samphire press, London, 1992) P.299.
2. Brian Greene: *The Elegant Universe:* P.149.
3. Lincoln Burnette: *The Universe & Dr. Einstein* (London Comet Books Collins, 1956) P.101-102.

of superspace whose dimensions are not three or four but infinite."[4] This universe created after the big bang of a superdense supernova, probably a blackhole (the historic word coined by John A. Wheeler), is disintegrating since 15 billion (000,000,000) years like splinters from a primeval explosion. Before Big Bang there was matter and anti - matter symmetry (equal amount of matter and anti-matter). Within the 1st second after the Big Bang this symmetry or balance of matter and anti-matter was broken and matter began to emerge in an overwhelming measure compared to anti-matter offering to us this material universe.[5] The last remnant of the great heat of Big Bang lingers today as 2.7° Kelvin radiation all over the empty space.[6]

Hubble calculated that the galaxies are moving away from one another with a velocity that is proportional to the distance that separates them. [V (velocity of recession), D (distance between groups of galaxies), and H (the Hubble constant 1/ $1.8x10^{10}$ years)- V=HXD[7]. The galaxy in the Hydra cluster is moving away with a speed of 61000 km per second.[8] The immensity of our universe made Stephen Hawking admit, "We are such insignificant creatures on a minor planet of a very average star in the outer suburbs of one of a hundred thousand million galaxies." The impenetrable mystery of the universe which is beyond ordinary human comprehension, made Hawking refute, in his Boston Lecture on *Blackholes are White Hot,* Einstein's famous dictum "God does not play dice." Hawking

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4. Cited in Huston Smith: *The Forgotten Truth* (New York: Harper Collins Books, 1976) P.102.
5. Paul Davies: *The Cosmic Blueprint:* (Heinemann: London, 1978) P.126-127.
6. Brian Greene: *The Elegant Universe:* P.349.
7. Paul Marshall: *The Living Mirror* (Samphire press, London, 1992) P.213.
8. Dr. J. V. Narlikar: *The Exploding Universe:* Illustrated Weekly of India Nov.6-12, 1983, P.8.

proclaimed, "God not only plays dice but throws them where they cannot be seen."[9]

The Uncertainty Principle rejected strong objectivity with the emergence of an omnijective (subjective + objective) universe and demolition of causality. Experimental verification of Bell's Theorem has established the existence of a non-local cause and a fundamental interconnectedness behind the apparently disconnected world. The Everette - Wheeler interpretation of Schroidinger's wave established the fact, through the classic example of Schrodinger's cat, that it is consciousness which creates reality outside. Schrodinger's wave equation has led to an observer - created universe. The Nobel-prize winning discoveries in Neurophysiology by Sir John Eccles and more recently by Roger Sperry of a non-physical consciousness, which transcends the physical brain-matter, but nevertheless works through the physical brain, are landmarks. All these new truths emerging out of 20th century scientific discoveries have pushed science from the domain of matter to the realm of philosophy, and specially the philosophy of consciousness as discovered by Vedanta Rishis some four thousand years ago.

The dream of an unified theory, the Holy Grail of modern physics for which Einstein started his race some sixty years ago, still haunts the physicists. It is a quest for a Theory of Everything or T.O.E., a grand unified theory, as dreamt by Stephen Hawking. It is the vision of a complete, consistent, unified theory in which all physical interactions are described by one set of equations. Today four separate theories are required to explain different features of the world; namely Newton's theory of gravity, Maxwell's equations of electromagnetism, Einstein's theory of relativity and the Quantum theory to explain sub-atomic

9. Michael White & John Gribbin: *Stephen Hawking* (VIKING) 1992. P.166, 172-173.

entities. The Theory of Everything dreamt of by physicists must accommodate all these four theories. The prospect of incorporating gravity into what the physicists would call a 'super-unified theory' was to, the 20th century physicists, 'just around the corner' for well over a decade. That decade is over. Hawking's century is over. The "Theory of Everything" for which Hawking started his quest has not been achieved until today. Still the dream continues.

At his inauguration as Lucasian Professor at Cambridge, Stephen Hawking delivered a memorable lecture, entitled 'Is the End in Sight for Theoretical Physics?', "May be the end is in sight for theoretical physicists, if not for theoretical physics," wrote Hawking's biographer." In an interview in *Newsweek* in 1988, Hawking said that after discovering 'a theory of everything there would still be lots to do', but physics would then be 'like mountaineering after Everest.'[10]

Era III of physics: A new revolution

Physics is poised, according to physicist Paul Davies, for a major revolution, not just rapid advances in technical details, but transformations of the very concepts upon which until today science is based. In physics such revolutions, according to Paul Davies, occurred twice before. The first was the systematic development of mechanics by Galileo and Newton. The second occurred with the theory of relativity and the quantum theory at the beginning of this century.[11] The third revolution, according to Paul Davies, has come with the interface of physics with biology. It is the discovery of steady unfolding of organisational complexity in the universe, especially in the self-organizing systems. Order leads to chaos, according to traditional mechanics of standard thermodynamics. In self-organising systems, on the

10. Ibid: P.252-53, 189, 261.

11. Paul Davies: *The Cosmic Blueprint:* (Heinemann: London, 1987) P.138.

contrary, Order leads to higher order and greater complexity. Symmetry leads not to broken symmetry but higher symmetry. **"We have seen", writes Paul Davies, "how spontaneous self-organisation tends to occur in far-from-open, on-linear systems with a high degree of feedback. Such systems, farfrom being unusual, are actually the norm of nature."**[12] In self-organising systems like life-forms, it is consciousness and non-material thought that acts on matter and leads to higher order. Physics does not have any law to explain such phenomena. Arthur Peacock explains this with clarity: **"Higher level concepts and theories often refer to genuine aspects of reality at their own level of description and we have to eschew any assumptions that only the so-called fundamental particles of modern physics are 'really real.'**[13]

This third revolution was prophesied by John A. Wheeler in his lecture on the Mystery & Message of Quantum delivered to American Physical Society on Feb. 1, 1984. Wheeler held out that the greatest task of modern physics will be to shift its foundation: **"And how can the hard-won structure of hard science be moved over, solid as ever, onto this new and other-worldly foundation ? Yet, despite all difficulties, and they are great, that must be the task and achievement of the coming Era II of physics."**[14]

The objective world started disappearing under the mounting pressure of quantum physics. The belief in the sure cause and effect relation was falsified with the emergence of uncertainty or indeterminacy in the sub-atomic world after Heisenberg's discovery of Uncertainty Principle in 1927. Heisenberg himself studied Eastern Mysticism with Tagore in India, in order to find parallels of new discoveries in physics and the ideas of Eastern

12. Ibid: P.142.
13. Ibid: P.143.
14. Fred Allan Wolf: *Taking the Quantum Leap:* (Harper & Row, N.Y. 1989) P.174.

philosophy. He also wrote two books in order to illustrate how physics had to move towards philosophy after the discoveries in quantum physics - *Physics and Philosophy* and *Physics and Beyond.*

The far-reaching impact of the demolition of casuality established by Heisenberg's Uncertainty Principle inspired Arthur Eddington to write: ".... **religion first became possible for a reasonable scientific man about the year 1927.... If our expectation should prove well founded that 1927 has seen the final overthrow of strict casuality by Heisenberg, Bohr, Born and others, the year will certainly rank as one of the greatest epochs in the development of scientific philosophy."**[16] Since the Everette - Wheeler interpretation of Schrodinger's wave equation Self - awareness or individual consciousness has gained upper hand. Quantum Physics has to accept the domain of non-physical mind or consciousness of the observer as an unavoidable factor in determining reality outside. The assumption that there exists, "out there," a real, objective reality, does not seem to exist without a perceiver of that reality. A simple particle, the electron which at times appears to be an electron cloud made up of an infinite number of possible electrons, "appear" as a single particle when and only when we observe one.[17] Consciousness and not matter, gives credibility to matter in the material world - this is the final thesis of physicist Amit Goswami. Commenting on physicist Amit Goswami's book on *The Self - Aware Universe,* physicist Fred Alan Wolf writes: "Science *seems to be signalling not only the end of a century but the end of science as we know it."*[18]

15. *The Holographic Paradigm and Other Essays: Exploding the Edge of Science :* Shambhala Publication, 1982, P.217-218.
16. A.D. Reincourt: *The Eye of Shiva:* (New York: William Morrow & Co., 1981) P.32.
17. Amit Goswami: *The Self-Aware Universe:* (Penguin, Putnam, N.Y. 1995) P.9.
18. Ibid: Introduction by F.A. Wolf.

In 1993 Ken Wilber wrote: **"The quantum revolution was so cataclysmic...because it attacked not one or two conclusions of classical physics but the very cornerstone....objective measurement to be the mark of absolute reality...because the measured and the measurer, the verified and the verifier, at this level are one and the same."**[19] Physics have pushed scientists to the brink of metaphysics, and sometimes forced them to enter the domain of philosophy to find meaning of their own discoveries. Strangely, the metaphysics of this new physics has come nearer to the monistic (Advaitic) philosophy of Vedanta than any other philosophy available in the West. Commenting on these new dimensions of physics A.D. Reincourt writes in his book *'The Eye of Shiva'*:

> **"A new spiritual vision is beginning to take shape under the spur of a most paradoxical alliance between new physics of the twentieth century and Eastern, rather than Western, mystical insight.**
>
> **The cardinal fact is that contemporary physics finds a remarkable echo in Eastern and not Western metaphysics; and that one of the prime elements of this conjunction is monistic and not monotheistic vision of underlying reality....(It is) perhaps the most outstanding cultural phenomenon of our times".... "In just a few decades scientific thought has moved light years away from the classical physics of nineteenth century."**[20]

The Philosophy of Vedanta:

The philosophy of Vedanta is enshrined in the Upanishads which form the concluding (anta) portion of the Vedas (veda).

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19. Ken Wilber: *Spectrum of Consciousness:* Illinois; U.S.A. 1993, P.24.
20. A.D. Reincourt: *The Eye of Shiva:* (New York: William Morrow & Co., 1981) P.18, 40, 171, 7, 114.

The Vedanta philosophers were not merely intellectual cogitators. They were *mantra - drastas*, or seers of universal truths. They were the discoverers of the various universal principles, through the power of their intuition based on pure thought. Here are some truths on which Vedanta philosophy stands :

1. Everything living and non-living is interpenetrated by Brahman, the all pervading consciousness *(Sarvam Khalu Idam Brahma - Chandogya Upanishad)*

2. The finite has infinite as its background. The smallest contains the greatest (*Anoranian Mahato mahiyan* - Katha Upanishad)

   The individual soul *(Atman)* is therefore identified with the universal soul *(Brahman) (Aham Brahmasmi - Brhadaranyaka Upanishad)*

3. The universe is full of energy which is derived from One cosmic energy or *Prana.*

4. It is a holistic universe where everything is fundamentally interconnected by a common background — the Brahman. *(Mayi Sarvam idam Protam Sutre Manigana iva — Bhagavad Gita)*

5. In this space-time-causation world of *Maya* things can happen without any apparent or local cause. *(Aghatana-ghatana patiyasi Maya)*

6. The external world which is transitory, therefore unreal, is created by our consciousness. *(Drisyah Dhivrittayah-Drik-Drsya-Viveka)*

How did Vedanta Rishis discover the Universal truths without any laboratory or experiments? The *Swetaswatara Upanishad* says the Ultimate Reality can be grasped by "pure heart, purified intellect and purified mind." *(Hrida manisha manasa Abhiclipto)*

Again Patanjali Vyas-bhasya (Yoga Sutra 44 Para 1) says that there are two kinds of intuitions. The first one is the empirical intuition (*Savichara Prajna*) which imposes forms of space, time, causation on real substance. The second is *Samadhi Prajna* or *Nirvichara Nirvikalpa Prajna* which is a relationless intuition of Reality in which the subject is capable of perceiving the essence or truth beyond space, time and causality.[21] Einstein said, "I hold it true that pure thought can grasp reality as the ancients dreamed."[22] These 'mystical overviews' or pure relationless intuition which inspired Einstein, Stephen Hawking, or Heisenberg, were behind the discoveries of the fundamental principles of Vedanta. Ken Wilber explains how in Eastern mystical experience intuition helps us to see Reality directly :

> **"In the mystical consciousness, Reality is apprehended directly and immediately, meaning without any meditation, any symbolic elaboration, any conceptualization, or any abstractions; subject and object become one in a timeless and spaceless act that is beyond any and all forms of mediation.**[23]

In a recent interview in Princeton America's living legend of Physics, John A. Wheeler said: "Philosophy is too precious a thing to be left to philosophers alone." Prof. Wheeler studied the Upanishadic ideas to get the answer to the ultimate problems of existence and felt optimistic for the little work done so far in India in this line. Commenting on the book *Modern Physics and Vedanta* (Bharatiya Vidya Bhavan, 1986) he wrote to the author in a letter (dt. June 10, 1999) -

> **"My wonderful mentor, Niels Bohr, had gone into deep interest into the Upanishads - more, he told me,**

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21. B.N. Seal: *Positive Science of Ancient Hindus:* Motilal Banarasidas, 1985, P.33-34.
22. Heinz Pagels: *The Cosmic Code:* (Bantam, N.Y. 1981) P.24.
23. Paul Davies: *Mind of God:* P.227-28.

in the questions than answer. ... I like to think that someone will trace out how the deepest thinking of India made its way to Greece and from these to philosophy of our times. ... Your wonderful analysis of the great questions inspire us all in the great research that follows the spirit of the Upanishads, of Plato's dialogue and modern science."

Philosophy of scientific materialism :

The idea that the objective world is the undeniable truth came in the West from Aristotle and other Greek philosophers. The spirit of strong objectivity of a commonly accepted world is evident in pre-Socratic Greek philosopher Heraclitus who wrote: **"Those who speak with a sound mind must hold fast to what is common to all. The waking have one common world, the sleeping turn aside into a world of his own".**[24] Parmenides, following Heraclitus, went further and declared that rational thought founded on a sure-objective-common world can grasp Absolute Truth. Both of them, as Karl Jaspers remarks, strongly rejected with a spirit of "exclusiveness, antagonism, a furious aggressiveness", all subjective elements from either science or philosophy.[25]

Newtonian science with its machine-like universe and a mechano-morphic God gradually brought a division between the universe, the automaton, and God, the ruling mechanic. A mechanical Paradigm discourages any evolutionary purpose or free will of the individual which only can inspire morality or ethics. Such a paradigm teaches one to submit to the rules and laws of a philosophy or a church which asserts that God also runs the world in a perfect mechanical order. Positivism, a by

24. Quoted in *The Eye of Shiva:* (Nww York: William Morrow & Co., 1981) P.58.
25. Ibid: P.59.

product of this mechano-morphic universe, was strongly advocated by science-philosophers like Ernst Mach. As a forerunner of logical positivism Mach said, 'Science may be regarded as a minimal problem consisting of the completest presentation of facts with the least possible expenditure of thought."[26] ... Mach also said, "Theoretical physicists should never use any idea in physics which cannot be given a precise, direct meaning through experimental operations."[27]

Nobel scientist Ilya Prigogine felt that Kant's philosophy furthered this division of mind and matter and brought a rift between science and philosophy. In agreement with the myth of classical science, Prigogine felt, Kant was after the unique language that science deciphers in nature, the unique set of a priori principles on which physics is based. Our world studied by science, the world accessible to positive knowledge is "only" the world of phenomena. ... Beauty, freedom and ethics cannot be objects of positive knowledge." They belong to the mental world which is the "domain of philosophy." Progigine felt that in this way Kant's philosophy "endorses and perpetuates the rift, debasing and surrendering the whole field of positive knowledge to science, "while retaining for philosophy the field of freedom and ethics, conceived as alien to nature."[28]

From the mechanistic paradigm, the objective external world of Matter emerged as the only object of scientific enquiring. 'Materialism' or acceptance of matter as ultimate reality, and 'positivism' as the primary method of scientific investigation emerged supreme.[29] Science stood out distinctly separate from

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26. Quoted in Edward Wilson: *On Human Nature:* (Harvard University Press. 1978) P.12.
27. Heinz R. Pagels: *The Cosmic Code :* (Bantam 1983) P.39-40.
28. Illya Prigogine & Isabella Stengers: *Order Out of Chaos* (Flamingo: 1985) P.88-89.
29. Collin Russel: *Science and Social Changes:* (Mcmillan 1893) P.244.

religion and philosophy which were supposed to deal with the realms of mind and thought. Majority of scientists in the 19th century accepted what Rupert Sheldrake, the Cambridge scientist, calls the **"traditional monistic materialism,"** or **"material monism"** and the **new religion of "scientific materialism began a triumphant journey."**[30] Material monism stood triumphant on its primary cornerstones like Strong objectivity, strict Causal determinism, Local cause and effect relation, and Epiphenomenalism, which claims that matter produces consciousness.[31]

Post - Kantian Hegel, according to Prigogine, stood against the materialistic - mechanical paradigm of old science. In his philosophy man stood superior to machine and the increasing levels of complexity in living organism was interpreted as a fulfilment of Nature's history with the appearance of man - that is with the coming of the spirit apprehending itself. Prigogine wrote: "The Hegelian philosophy of nature, systematically incorporates all that was denied by Newtonian science. In particular it rests on the Qualitative difference between the simple behaviour described by mechanics, and the behaviour of more complex entities such as a living being."[32]

Matter: Real or Unreal?

With the emergence of the Quantum physics the vision of a solid matter-based universe began to turn hazy. Schrodinger asserted that 'not only can an electron not be observed twice, but not even once, as the consistent application of Heisenberg's Uncertainty principle asserts.' Movement of abstract, wave-like, almost unreal electrons and their occupying a position, and the possibility of one electron's simultaneous presence in many other

30. Rupert Sheldrake: *The Presence of the Past* (N.Y. Jame Books 1988) P.211.
31. Amit Goswami: *The Self Aware Universe:* Penguine Putnam N.Y. 1995, P.17.
32. Illya Prigogene & Isabella Stengers: *Order Out of Chaos* P.88-89.

places, baffled scientists. John A. Wheeler wrote of an interesting incident, when three great physicists were discussing about electrons.

> **"The professor at Copenhagen whom Niels Bohr most admired, who was his teacher and subsequent occupant of the house of honor that Bohr himself was to occupy, was Herald Hoffding. In an evening dialogue between Heisenberg and Bohr at that house of Honor about the uncertainty principle, Hoffding put his finger on the diagram between the double entrance slit and the terminating photographic plate and asked, "Where can the electron be said to be?" Bohr's reply is immortal: "To be? To be? To be? What does it mean, 'to be'?"**[33]

The picture of electron turned to be a statistical probability in an electron cloud. Louis De Broglie's electron-diffraction experiment showed that electrons also behave as waves. In fact the wave-particle duality puzzled scientists. Some of them termed all sub-atomic particles as *'wavicles'* (wave+particles). Max Born completed the baffling scene by finally declaring that electrons are not even real waves. They are, said Max Born, **'Probability waves' which is 'a purely abstract ... mathematical concept ... in which we cannot enter.'**[34] As if to add to the complexity of the new physics, Max Born showed that while the waves of a single electron can be represented in three dimensional space, the waves of two electrons requires a six-dimensional space, and three electrons a nine-dimensional space and so on ad infinitum.[35] Where from come those dimensions? Can our intellect conceive of such a thing?

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33. John A Wheeler Letter to Swami Jitatmananda dt.10.6.99, Dept. of Physics, (Joseph Henry Lab.) Princeton University.
34. Gary Zukov : *The Dancing Wu Li Masters:* (N.Y. William Morrow, 1981) P.128.
35. A.D. Reincourt : *The Eye of Shiva:* P.25.

In a recent interview in Princeton University (held on 7 January 2000). John A. Wheeler, told the author that the equation which impressed him most in modern times is an equation from Hamilton's algebra. This was applied by John D. Valera for the measurement of electron spin. The equation, $i^2=j^2=k^2=ijk=-1$, is part of Hamilton's algebra, and an extension of Complex numbers. It was during a moment of epiphany a sudden revelation of truth, that Hamilton discovered this equation which he called **"the fundamental formula."** Hamilton wrote about this discovery, which happened when he was walking along a royal canal and crossing a bridge.

"An electric current seemed to close and a spark flashed forth, the herald (as I foresaw immediately) of many long years to come of a definitely directed thought and work...I pulled out on the spot a pocket-book which still exists, and made an entry there and then. Nor could I resist the impulse unphilosophical as it may have been to cut with a knife on a stone of Brougham bridge, as we passed it, the fundamental formula with the symbols, I, J, k,: $i^2=j^2=k^2=ijk=-1$ which contains the solution of the problem.[36]

The equation was applied by Irish physicist De Valera to electron's spin or rotation. It suggests that electron when measured in all its three dimensions - spin (i), momentum (j), and position (k), turns out to be −1. De Valera's -1 is not √-1 used by Physicist Pauli to define the spin of electron. A Calcutta physicist explains: "De Valera's triple product ijk is equal to (-iÜx) (-iÜy) (-iÜz) in Pauli's notation and is also equal to -1 from the well-known property ÜxÜyÜz = i of the Pauli operators"[37] While √ -1 is imaginary, -1 can be philosophically interpreted as unreal. Is the objective world composed of electrons

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36. B.L. Vander Waerden; *A History of Algebra* from al-Khwarizmi to Emmy Noether: Springer Verger, 1985 : P.177-190.
37. Narendrapur Samachar: 2001, P.75 (Narendrapur, West Bengal, India)

then fundamentally unreal? Advaita Vedanta says, "The phenomenal world is ultimately unreal. The stable background of this unreal world, Brahman, the Absolute Consciousness, alone is real - *(Brahma Satya Jagat Mithya)*.

Nevertheless our objective world remains and persists. Why? Although each individual quantum may be genuinely unpredictable, "a collection of such events conforms of contingency and intelligibility," writes philosopher Ian Barbour, "which prompts us to search for new and unexpected forms of rational order."[38]

String theory:

But materialism is destined to die, if at all, hard. The old reductionist passion of discovering the fundamental building block of matter behind the material universe, continues. So long Quarks theory had fascinated the physicists. But the Quarks theory failed to satisfy some basic questions. "What is the value of Quarks if they are permanently confined inside hadrons or heavy subnuclear particles?" - ask the physicists. Probably as a reaction to the inadequacies of physics, some physicists have come forward to explain the fundamentals of matter as made of "strings". The central idea of string theory is that entities such as electrons and quarks are actually linear - tiny 'strings". Strings are the smallest conceivable element in the universe. One string is less than 10-30 cm in space. A typical atomic nucleus is about 10-13 cm across. So a nucleus is about a hundred million billion times bigger and than the knots in the structure of space. It would take 10^{20} of these strips laid end to end, to stretch across the diameter of a proton.[39] According to string theory, the elementary ingredients of the universe are not point particles.

38. Paul Davies: Mind of God: P.192.

39. White & Gribbin (Viking) : *Stephen Hawking:* P.256-60.

Rather, they are tiny, one-dimensional filaments somewhat like infinitely thin rubber bands, vibrating to and fro.[40]

Special relativity of Einstein's showed that nothing can travel faster that the speed of light. The experimental verification of Bell's theorem by David Bohm, Clauser and Freedman, and finally by Alain Aspect, shows by contradicting Einstein that faster than light (superminal connection) is possible. Latest development of quantum mechanics thus stands incompatible with Einstein's relativity. The Superstring theory claims that relativity and quantum mechanics are not mutually contradictory, but complementary. One requires the other to make sense of the string theory.[41] At 10-43 second (Planck's time) after the Big Bang when the temperature was 10^{28} Kelvin, the density of the universe was colossal and all the energies - that is gravity and quantum mechanical forces - were one. It is at this state that scientists search for the string theory to provide one basis for all the forces.[42] In the mid-1970s two of 'strings' researchers, Joel Scherk in Paris and John Schwarz at Caltech, actually found a way to describe gravity using string theory. The string theory in the mid-1980s, turned satisfactory as these theories *automatically* included in the graviton - the unit of gravitation.[43]

Advocates of string theory thinks of this theory as possibly being the "theory of everything" (T.O.E.) In a reductionist way it hopes to reduce absolutely everything to string. They have high hopes that the mysteries of black holes and concepts like spin, the family structure of matter particles, messenger particles, guage symmetry, the equivalence principle, symmetry breaking, and supersymmetry, will emerge naturally from string theory.[44] In 1995 conference held at the University of Southern California

40. Brian Green: *The Elegant Universe:* (A Vintage Book: USA, 2000) P.135-36.
41. Ibid: P.4. 42. Ibid: P.350.
43. White & Gribbon (Viking): *Stephen Hawking:* P.256-60.
44. Brain Greene: *The Elegant Universe:* P.383, 344.

- Edward Written announced a plan for taking the next step, thereby igniting the "second superstring revolution."[45]

But questions have started rising about the validity of this theory. In an article in *Scientific American* in 1986, one of the pioneers of Strings Theory, Michael Green of London, pointed out that with string theory details have come first. *"We are still groping for a unifying insight into the logic of the theory.* The occurrence of the massless graviton ... appears accidental and somewhat mysterious", he said. What appeared to be the best versions of *Superstring theories,* the ones in which gravitons seem to emerge naturally from the equations, "only work with matter of *twenty-six dimensions."* "Where are all the extra dimensions hidden?" asks Green.[46]

Brian Greene, the well-known protagonist of S-theory feels like Jacob Bronowski who said that "in a every age there is a turning point, a new way of seeing and asserting the coherence of the world." Despite his faith in the future success of the String theory Brian Greene admits: "There will nevertheless be aspects of the universe that remain unexplained. May be we will have to accept that certain features of the universe as the way they are because of happenstance, accident, or divine choice."[47]

Is matter Conscious?

While Erwin Schrodinger described electron as standing waves, physicist Max Bohr described electron as probability waves. This non - classical idea of electron as "Probability - waves" of Max Born, physicist Richard Fynmann tried to explain in his 1950 B.B.C. lectures.[48] When the electrons were sent through a double-slit experiment, the electrons started from their

45. Ibid: P.140.
46. White & Gribbin (Viking): *Stephen Hawking:* P.256-60.
47. Brian Green: *The Elegant Universe:* P.385, 387.
48. Heinz Pagels: *The Cosmic Code:* (N.Y. Bantam New Age Book) P.115-122.

source as particles, and they reached the target screen as particles, but in between they behaved as waves, interfering with each other enhancing, or nullifying the intensity of movement. This is like some obedient school children who came out of their home as students and reached the school as obedient school students and yet in between they played and fought with each other as players in the fields on the road side. No mechanical movement can explain this phenomena known as *Quantum mechanical tunneling*. Are the electrons capable of conscious decisions? An electron particle when confronted with a big barrier, surmounts it by transforming itself into a wave, and then again moves as a particle. This is a phenomenon which only living organisms display. Physicist Heinz Pagels wrote:, "This is rather weird and no ordinary idea of objectivity can accommodate it."[49] "Physicists found themselves dealing with energy", writes Gary Zukav in his popular book, *The Dancing Wu Li Masters,*[50] "that somehow possessed information (which made it organic), and unaccountably presented itself in patterns (waves)". Illya Prigogine, the Nobel scientist, comments on his own book *Order out of Chaos:* "This is the heart of the message ... in my book, matter is not inert. It is alive and active." Physicist Freeman Dyson of Princeton, said,

> **"In other words mind is already inherent in electron and the process of human consciousness differ only in degree but not in kind from the processes of choice between Quantum states which we call "Chance" when they are made by electrons."**[51]

Physicist Jack Sarfatti writes: **"I suspect that general relativity and quantum theory are simply two**

49. Heinz Pagels: *The Cosmic Code:* (N.Y. Bantam New Age Book) P.122.
50. Gary Zukav: *The Dancing Wu Li Masters:* P.90.
51. Freeman Dyson: *Disturbing the universe* (N.Y. Harper & Row, 1979) P.249.

> **complementary aspects of a deeper theory that will involve a kind of cosmic consciousness as the key concept".**[52]

Long before Max Born appeared on the scene, in 1901 Indian biologist J.C. Bose demonstrated his epoch-making experiments of human like response in metals in the physics section of British Association at Bradford. Scientists saw with wonder the similar curves of human muscles and metals and plants, when they were responding to the effect of fatigue, depression and poisonous drugs. Bose's discovery conclusively proved that the same Consciousness pulsates in man, plants, and even metals in various ways. Bose summed up the essence of his findings.

> **"In many investigations on the action of forces on matter, I was amazed to find boundary lines vanishing and to discover points of contact emerging between the living and non-living."**

> **"The physicist, the chemist and the biologist come in by different doors, each one in his own department of knowledge, and each comes to think that this is his special domain unconnected with that of any other. Hence has arisen our present division of phenomena into the worlds of inorganic, vegetal and sentient. This philosophical attitude of mind may be denied. We must remember that all inquiries have as their goal the attainment of knowledge in its entirety."**[53]

Commenting on Bose's successful experiment, the then English metal scientist Sir Robert Austin admitted that he was happy to see that metals have life. The wellknown Science Journal,

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52. Michel Talbot: *Mysticism & New Physics:* (Bantam, 1981) P.82.
53. Peter Tompkin & Christopher Bard: *The Secret life of Plants* (Penguin U.S.A., 1974) P.81-86.

Nature commented that Bose's experiment proceeded so smoothly and logically and yet it does not start from any place in the existing corpus of knowledge.[54]

Vedanta philosophy asserts through all the Upanishads that it is one Consciousness which manifests through the myriads of entities within the universe, living or non living. *Sarvam Khalu Idam Brahma* (Everything in this Universe is Brahman (Existence - Consciousness - Bliss Absolute) says, *Chandogya Upanishad.* The *Isa-Upanishad* asks us to see the One Supreme consciousness in all things of this phenomenal universe *(Isa Vasyam Idam Sarvam Jat Kincha Jagatyam Jagat.)*

Universe - a sea of Energy: Energy comes from consciousness

Paul Dirac, in a new line of thinking, formulated the field concept of electron. In this new 'Quantum relativistic' model of sub-atomic physics which is still the most successful, the primary concept is of 'Quantum field', that is, of a field of energy which can take the form of quanta, or particles. "There is no place in this new kind of physics both for field and matter, for the field is the only reality," said Einstein.[55]

According to Uncertainty Principle, no electron or not even the smallest particle (which is also a field) can measure zero. The so-called empty space as a rule contains an enormous amount of waves. Waves are also particles and particles generally have mass, and mass is energy according to Einstein's equation $e=mc^2$. The empty space emerged as an ocean of energy. Astronomer Hubble studied samples of space over the years and found that every cubic centimeter of empty space contains 10-24 gms. of matter.[56] The total no. of particles in the universe, as calculated

54. Peter Tompkin & Christopher Bard: *The Secret life of plants* (Penguine U.S.A., 1974) P.81-86.
55. Fritzof Capra: *Tao of Physics* (Fortune Y. Collin 1976) P.220-21.
56. Lincoln Burnette: *The Universe & Dr. Einstein:* P.101-102.

by Eddington is N = 2X136X2256 = 10^{79} approx.[57] And a cubic meter of so called empty space contains, besides other particles, 400 millions of photons.[58] According to Stephen Hawking, the gravitational field at the event horizon of a black hole is strong enough to do an astounding thing - turning the virtual particles, even those unfortunate ones with negative energy to "real" particles.[59] The universe emerged as an ocean of energy which the physicists call the 'Dirac sea' of energy.

This ocean of cosmic energy the Indians first conceived as ADI SHAKTI - the Primeval COSMIC ENERGY creating and sustaining the universe. Later Hinduism called this as KALI. According to Vedanta space is Brahman *(Kham brahma: Chandogya Up. 4.10.4)*. Space is verily a play of cosmic energy *(Prana vai Satyam: Br. Up. 2.3.6.)*. Empty space is the sea of continuous creation-destruction dance of Energy symbolized by Indian *Nataraja Shiva,* as Fritzof Capra has shown in his book *Tao of Physics.*[60]

Where from does motion or energy come? A conscious being only has motion. Consciousness is the root of all energy. Brhadaranyaka Upanishad calls the Ultimate Reality or Consciousness as *'Satyasya Satyam'* (2:3:6) (The Truth behind the apparent truths of the phenomenal universe). It is Cosmic Consciousness, according to Vedanta, which is at the basis of Cosmic Energy. Hindus believe that KALI creates, sustains and destroys, only in the presence of SHIVA - The Absolute consciousness.

Consciousness creates Reality outside:

After the discovery of Heisenberg's Uncertainty Principle, the

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57. Paul Marshall: *The Living Mirror* (Samphire press, London, 1992) P.267.
58. Brian Greene: *The Elegant Universe:* P.349.
59. Kitty Ferguson: *Stephen Hawking* (Bantam Book, 1992) P.77-78.
60. Fritzof Capra: *Tao of Physics* (Fortune Y. Collin, 1976) P.257-59.

detached observer-scientist of classical physics is no more a detached observer of the classical physics, looking through the microscope at something separate from himself. He is both the 'actor' and 'participator' as physicists James Jeans and John A. Wheeler put it, in the great drama of existence. The subjective and objective have been fused into one *omnijective* reality, as Michel Talbot calls it in his book *Mysticism and New Physics*.

Already electron the particle, proved to move as a wave in Broglie's electron diffraction experiment. All particles suddenly were found capable of behaving both as particle and a wave. But quantum physics was heading towards another surprise. In Schrodinger's wave equation this omnijective reality ultimately appeared to be a creation of the subjective alone. Erwin Schrodinger's Wave equation opened a Pandora's box to scientists. In certain circumstances Schrodinger's wave function predicted the behaviour of a given particle upto a point and then described two equally probable outcomes of the same particle. The two outcomes then branch into four, eight, sixteen, and so on to *ad infinitum* possibilities. In fact the wave equation suggests an endlessly proliferating number of possibilities for the observed system (external reality) whether it is observed or not. It seemed that an electron, in Schrodinger's wave, can parade at the same instant simultaneously in many forms, say as a saint or a sinner, a thief or a police. Schrodinger tried to explain this strange phenomenon through his *thought-experiment* known as *Schrodinger's Cat.* A live cat is thrown in a black box in the void. The box has got a mechanical device which will eject one electron. If the electron touches the poisonous bulb inside the black box as a particle, the bulb will burst, the poison will come out and the cat will die. If the electron comes as a wave, the bulb will not burst, the poisonous gas will not come out, and the cat will not die. Now the electron which has been shot in this box in the void develops Schrodinger's Schizophrenia, and

it can move both as a wave and a particle at the same instant. The question now arises. What has happened to the cat?

The first answer from classical physics is simple. The old vanguards say that the cat is either alive or dead. It is useless to ask big philosophical questions. According to the Copenhagen interpretation of Quantum physics, nothing can be said until the box is opened and the reality is observed. One of the possibilities will emerge and the second possibility will collapse (Copenhagen Collapse) only after we observe it. Then only the final answer will be available.

The third interpretation is given by Graham, Hugh Everett and John A. Wheeler who interpreted that in Schrodinger's wave equation the wave function is the real thing. All the possibilities that it represents are real and they all happen. This is known as the *Many World Interpretation of Quantum Physics*. The interpretation has opened unprecedented possibilities of human creativity and higher evolution. We can see the world according to our states of consciousness. The cat is both alive and dead at the same time. It is dead for them who 'choose' to see it dead. It is alive for those who 'choose' to see it alive. Sinners like Magdalene or Amrapali who were hated by the so called virtuous, became an object of hatred to commoners and at the same instant they became an object of compassion and care to Buddha and Christ, and an object of adoration and respect to Shri Ramakrishna. Physics has laid the rational foundation for these different visions of reality at the same moment. We create the world with our own ego, desires, mind and intellect.

According to Copenhagen interpretation of Quantum Mechanics Schrodinger's wave equation generates an endlessly proliferating number of possibilities. "According to the Everette-Wheeler-

Graham theory, the same development generates *an endlessly proliferating different branches of reality,"* writes Michael Talbot.[61] "It might seem that if we cannot observe anything without changing what we observe, we should perhaps drop the idea that anything exists without our observing it," writes.[62] physicist Fred Allan Wolf.

A similar conclusion was arrived in Vedanta philosophy a thousand years ago. Drg Drsya Viveka, a well-known Vedanta treatise, writes: *drsyah dhi brttayah saksi drg eva na tu drsyate.* **"All the scenes before us are projections of our intellect (activated by the presence of our consciousness). The only seer is the Self (the pure Consciousness) inside us. This Self cannot be seen because it is itself the Seer." (verse:1)] Says the Brhadaranyaka Upanishad (1:5:9): 'Whatever is to be known is a form of the mind; because the mind is what is to be known.'**

Today biology comes forward to endorse this idealistic view. In his book *The Astonishing Hypothesis,* Nobel biologist Francis Crick writes:

> **"My second general remark is that any one aspect of the visual information provided by your eyes is usually ambiguous." ... It is difficult for many people to accept that what they see is a symbolic interpretation of the world - it all seems so like "the real thing." ... "Seeing involves active processes in your brain that lead to an explicit multilevel, symbolic interpretation of the visual scene."[63]**

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61. Michel Talbot: *Mysticism & New Physics:* (Bantam, 1981) P.38.
62. F.A. Wolf: *Taking the Quantum Leap:* P.201.
63. Francis Creek: *The Astonishing Hypothesis* (Charl's Scribners & Sons, N.York 1994) P.28-35.

> **The same Vedanta text Drg - Drisya - Viveka says: External forms are objects of vision, and the organ of eye sees it. Again the organ of eye is the object of vision and the mind inside sees it *(Rupam drisyam Lochanam drik tat drisyam drik tu manasam.")***

Everette-Wheeler Interpretation makes the existence of parallel universes seem more and more real, and quantum physics opts for the view that the external reality is the creation of the observer's mind. Another interpretation suggested by physicist F.A. Wolf, is the *trans-actional interpretation* of Quantum Physics which asserts that the future communicates with the present. In this interpretation, a physical system can actually appear to move from the present into the future, and backward through time from the future to the present.[64] Katha Upanishad says: He, the Infinite Consciousness, is the ruler - controller of past and future, and therefore, he is not afraid of anything *(Isano bhuto bhavyasya tato na Vijugupsate).*

Nobel physicist Eugene Wigner, suggests that our consciousness alters the world by altering us. *It affects how we appraise the future.* And it does this by altering our own quantum wave functions. *It is our wills (our choice) that change those probable futures into an actual present.* Wigner describes the process :

> **It is the entering of an impression into our consciousness which ... modifies our appraisal ... for different impressions which we expect to receive in the future. It is at this point that the consciousness enters the theory unavoidably and unalterably.**[65]

Wigner asserts that consciousness is the primary concept and that a mere materialistic approach to know external reality is

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64. F.A. Wolf: *Taking the Quantum Leap:* P.254.
65. Ibid.

not enough: "**The principal argument against materialism is that thought processes and consciousness are primary concepts, that our knowledge of the external world is the content of our consciousness and that the consciousness, therefore, cannot be denied. On the contrary, logically, the external world could be denied - though it is not very practical to do so.**"[66]

Physics entered the domain of philosophy, with the undeniable supremacy of consciousness in determining the final outcome in Quantum observation, and more importantly the rejection of the strong objectivity of classical science, so fondly cherished by Greek philosophers and Newtonian physics. Physicist Wolfgang Pauli told Heisenberg that this freedom from the old idea of an objective world running according to strict cause and effect relation opened the door for the reconciliation of science and philosophy. Heisenberg wrote:

> "**... it was precisely the idea of an objective world running its course in time and space according to strict causal laws that produced a sharp clash between science and the spiritual formulations of the various religions. If science goes beyond this strict view - and it has done just that with relativity theory and is likely to go even further with quantum theory - then the relationship between science and the contents religions try to express must change once again.**"[67]

The wave-equation increasingly confirms that it is our mind-consciousness which chooses the outcome of the observation. Since this outcome is our conscious experience, says physicist

66. Eugene Wigner: Symmetries and Reflections: 1967: Indian University Press.: P.177.
67. Werner Heisenberg: *Physics and Beyond:* (N.Y. Harper & Row, 1971) P.84.

Amit Goswami in his book *The Self-Aware Universe*, it is equally true that, we choose our conscious experience - yet we remain unconscious of the underlying process. Many physicists view the selection process as random, an act of pure chance. This view provoked, according to Goswami, Einstein's protest that *God does not play dice.*[68] But if God does not play dice, asks Goswami, who or what selects the result of a single quantum measurement? Descartes taught - *cogito - Ergo - Sum - I think therefore I am.* After Aspect's experiment Dr. Goswami feels the new dictum should be - *Opto-Ergo Sum (I choose therefore I am)*. Quantum Physics, as opposed to the strict cause and effect relation of old physics, allows free will to choose, and thereby encourages creativity and provides scope for evolution. According to the idealist interpretation of Vedanta, it is consciousness that chooses - but it is a non-local unitive consciousness which works through the ego, intelligence and mind of human beings, says physicist Amit Gowsami.[69]

Interface of physics and Biology: Emergence of Holistic consciousness acting on matter:

The Era III of physics, anticipated by John A. Wheeler, with the new other-worldly foundation of consciousness emerges more powerfully in the interface of physics and biology. Scientists are trying to understand not what things are made of but how they are put together and function as integrated wholes, especially in living organisms. What is sought is not a *Theory of Everything or TOE* but a general *'Theory of Organisation' or T.O.O.* according to physicist Paul Davies.[70] **The question, according to Paul Davies, is whether self-organizing systems "can be understood by the known laws of physics, or whether**

68. Amit Goswami: *The Self-Aware Universe:* P.174-175.

69. Ibid.

70. Paul Davies: *The Cosmic Blueprint:* (Heinemann: London, 1987) P.138

completely new fundamental principles are required."[71] The trend is towards ever-greater organizational complexity where things move not from order to chaos, as the traditional laws of Thermodynamics insist, but from order to higher order. This new movement of matter from order to higher order is according to Paul Davies, "a conspicuous feature of the universe." **It is frequently regarded as a puzzle because "it seems to go the wrong way from a thermodynamic point of view."**[72] Paul Davies says:

> **"If we accept that there exists a propensity in nature for matter and energy to undergo spontaneous transitions into new states of higher organizational structures, ... I have been at pains to argue that the steady unfolding of organized complexity in the universe is a fundamental property of nature."**[73] ... **"The origin of life, the evolution of increasing biological complexity, and the development of the embryo from a single egg cell, all seem miraculous at first sight, and all remain largely unexplained."**[74]

Cambridge zoologist W.H. Thorpe speaks with the same conviction:

> **The behaviour of large and complex aggregates of elementary particles, so it turns out, is not to be understood as a simple extrapolation of the properties of a few particles. Rather, at each level of complexity entirely new properties appear, and the understanding of these new pieces of behaviour requires research which is as fundamental as, or perhaps even more fundamental**

71. Ibid.
72. Ibid.
73. Ibid.
74. Ibid. P.139.

than anything undertaken by the elementary particle physicists.[75]

Since the last sixty years biologists are trying to conceive of a single force-field in a living organism. In 1960s, F.S.C. Northop and Harold Saxton Burr postulated this field as the bio-gravitational field or the L-field.[76] Recently Rupert Sheldrake, a Cambridge scientist, has started building up, on the basis of some of his successful experiments, a similar idea of *morphic field.*

The latest discoveries in physics have proved that particles of matter are fields of energy. "Yet this new vision of the physicists has so far had very little effect on the understanding of living organism", writes Rupert Sheldrake. "Quantum physics has dissolved atoms or subatomic particles into quantized fields of energy. Yet in the field of biological research much of the old atomistic way of thinking has persisted." The morphic fields of cells, tissues, organs, and living organism have, according to Sheldrake, so far been described "only in vague and general terms."[77]

The morphic-field or the energy-field in a living organism works in a way which is strikingly different from a mere mechanical function. In fact they work in a holistic way. A branch of a tree, when planted, develops into a full-fledged tree. A sea urchin cut into two develops into a full sea urchin. A liver whose parts have been removed, develops into a full liver. Rupert Sheldrake writes: "The capacity to regenerate is, in fact, one of the most fundamental features of living organisms, and

75. Ibid. P.139.
76. Peter Tompkins and Christopher Bard: *The Secret of Plants:* Penguin, U.S.A. 1974: P.175.
77. Rupert Sheldrake: *Presence of the Past:* Times Book, U.S.A.; P.119.

any theory of life has to try to explain it... Process of regeneration reveals that in some sense organisms have a wholeness that is more than the sum of their parts; parts can be removed, and yet wholeness can be restored." And this holistic function of living organism has so far not been explained by the laws of physics. But new thoughts are emerging.

Nobel physicist Winger speaks of his 'firm conviction of the existence of biotonic laws'. He asks: Does the human body deviate from the laws of physics, as gleaned from the study of inanimate matter?' He goes on to give two reasons involving the nature of organic consciousness and argues that the laws that guide the growth and evolution of living organism are different from the laws of physics of matter. One reason is the supremely important role of consciousness in quantum mechanics. The second reason is the simple fact that in physics action tends to provoke reaction. This suggests to Winger that, because matter can act on mind (e.g. in producing sensation) so too should mind be able to react on matter.[78]

This fact that mind acts on matter is one of the most fascinating frontiers of science where physical laws become subservient to the functioning of organic consciousness. Nobel-scientist R.W. Sperry who has conducted extensive experiments on split-brain subjects, rejects reductionist explanations of mental phenomena which says all mental phenomena can be ultimately reduced to physical and chemical reactions. He argues instead for the existence of something like *downward causation.* It is technically known as **emergent interactionism** of consciousness on matter. Sperry asserts that higher-level entities possess laws and principles in their own right that cannot be reduced to lower-level laws. Speaking about cerebral function Sperry says,

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78. Paul Davies: *The Cosmic Blueprint:* (Heinemann: London, 1987) P.147.

> **These large cerebral events as entities have their own dynamics and associated properties that causally determine their interactions. These top level systems' properties supersede those to the various subsystems they embody.**

Sperry explicitly states that *'mental forces or properties exert a regulative control influence in brain physiology.'* How does the 'mental force' exert a downward causality on physical brain matter? Sperry explains, **"Once generated from neural events, the higher order mental patterns and programs have their own subjective qualities and progress, operate and interact by their own causal laws and principles which are different from, and cannot be reduced to those of neurophysiology...The mental forces do not violate, disturb, or intervene in neuronal activities but they do supervene...Multilevel and interlevel causation is emphasized in addition to the one-level sequential causation traditionally dealt with."**[79]

Sperry talks of the lower-level entities becoming 'caught up' in the holistic pattern, just as a water droplet is caught up in a whirlpool and constrained to contribute cooperatively to the overall organized activity.[80]

Long before Sperry, Arthur Eddington spoke of the distinction between matter and consciousness: **"... the distinction between ordinary matter and conscious matter is that in ordinary matters there is no correlation in the undermined parts of the behaviour of particles, whereas in Conscious matter correlation may occur."**[81] In the same tune celebrated geneticist J.B.S. Haldane declared : **"Science must ultimately aim at**

79. Paul Davies: *The Cosmic Blue Print:* (Heinemann: London, 1987) P. 192.
80. Ibid. P.191-192.
81. A.D. Reincourt: *The Eye of Shiva:* P.183-84.

gradually interpreting the physical world of matter and energy in terms of biological conception of organism." Another scientist echoed Haldane: **"The notions of physics will have to be enriched, and their enrichment will come from biology".**[82]

Physicist Niels Bohr asks in the same tune how consciousness can be explained by physical and chemical laws:

> **"The word consciousness, applied to ourselves as well as to others, is indispensable when dealing with human situation." In view of all these how the claim of materialism, that "life could be explained by sophisticated combination of physical and chemical laws could so long be accepted by scientists",**[83] asks Niels Bohr.

Nobel Scientist George Wald regretted that scientists in general do not pay necessary attention to this dimension of modern science, namely the issue of Consciousness:

> **"Biologists tend to be embarrassed by consciousness. As an attribute of some living organism, they feel that they should know about it and should indeed be in a position to straighten out physicists about it none of which has come their way. Hence the discomfort, the avoidance, or worse; talking ancillary mechanism that dodge the essential problem."**
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> **"If I say, with Eddington, to put the conclusion crudely - the stuff of the world is mind-stuff, scientists doubt it has a metaphysical ring." But, says Wald, if he speaks of equations of quantum mechanics, quantum electrodynamics, and quantum field theory, that sounds to the scientists like good, modern physics. "Yet what are those equations, indeed what is mathematics, but**

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82. Ibid.
83. Niels Bohr: *Atomic Physics and Human knowledge*: (Wiley N. York, 1958) P.92.

mind-stuff ?.... The material universe, is then an Avatara, the materialisation of primal mind."[84]

Prof. Wald realized the importance of Eastern philosophy in defining the role of a non-local consciousness, in our human life.

"A few years ago it occurred to me - albeit with some shock to my scientific sensibilities - that my two problems, that of a life - breeding universe, and that of consciousness that can neither be identified nor located, might be brought together. But very quickly I realised that I was in excellent company. Not alone are rudiments of this kind of thought deeply embedded in millennia-old Eastern philosophies; it is stated explicitly or strongly implied in the writings of quite recent and some present physicists.[85]

The interface of physics and Biology has not only revealed an increasing importance of mind and consciousness but also brought a new renaissance of Consciousness in Science. Physicist Amit Goswami writes:

I believe that such a massive movement of consciousness can be called a renaissance. Such transitional periods have occurred in many cultures and civilizations. The next such renaissance, which perhaps is a-birthing, will be a very special one since, thanks to modern communications technology, humanity is now interconnected. The next renaissance will have worldwide reverberation; it will be global renaissance of peace.[86]

Science moves away from a dualistic to a holistic universe:

Physicists David Bohm, John Clauser and Freedman who successfully experimented on Bell's Theorem in 1972, proved

84. George Wald: *Life and Mind in the Universe: Paper submitted to NCERT* Seminar: Feb, New Delhi; 1987.
85. Ibid.
86. Amit Goswami: *The Self-aware Universe:* P.271.

that two similar photons (in the experiment with twin photon pairs) always and instantaneously communicate with each other. Even when the twin photons are theoretically separated by an astronomical distance (a distance that light takes several seconds to travel), the condition of one photon is immediately conveyed to its twin. How could instantaneous communication between two distant objects be possible? Einstien's theory of Relativity shows that 'faster than light' or 'superluminal communication' is not possible. According to Einstein the fastest speed in this universe is the speed of light which is 1,86,000 miles per second. How can two particles who are separated by a distance, for example, of 10 lakh miles, be connected instantaneously? Even the fastest communication speed will take at least 5 seconds to connect such paired particles. But the successful experiment of Bell's theorem has established the fact that superluminal, instanteous connection is indeed possible. Alain Aspect, along with colleagues, Jean Dalibard and Gerard Roger, added in 1982 and 1985 the refinements necessary to make the results unequivocal. They found that the communication was *'almost instantaneous.'*

Einstein could not accept this non-local communication. He felt there must be some 'hidden variable' behind this non-local connection. Until today no such hidden variable has been discovered. Eugene Winger suggests that "it is the consciousness of the scientist which is itself the hidden variable."[87] **American physicist Henry Stapp in 1975 declared that Bell's theorem is the "most profound discovery of science." He asserted that "our ordinary ideas about the world are somehow profoundly deficient even on the macroscopic level".**[88]

David Bohm proposed, in order to explain the non-local instantaneous communications, the theory of *implicate order* in

87. Michel Talbot: *Mysticism and New Physics:* P.33.
88. Gary Zukav: *The Dancing Wu Li Masters:* (N.Y. William Marrow & Co. 1979) P.314, 306.

which all things and events are enfolded in a total wholeness and unity. The implicate order is not inserted into material system in space and time, but the explicate order of space and time, of matter and events unfold from this underlying order. It is a holistic universe where matter floats like 'Quantum foam' as Wheeler calls it, on one single underlying order which Bohm calls the 'implicate order'. Bohm wrote:

> **"The essential new quality implied by the Quantum theory in non-locality i.e. that a system cannot be analysed whose basic properties do not depend upon the whole system...This leads to new notion of unbroken wholeness of the universe."[89]**

This 'implicate order', according to David Bohm, is 'primary', 'self-existent', 'universal', and 'an unidentifiable totality'. This is the ground for both 'life-explicit' and 'inanimate matter', whose functioning go on in an 'unbroken and undivided totality'. This is BRAHMAN, the substratum of all things, 'living' and 'non-living' described in the Upanishad. Bohm's idea of 'implicate order' is approaching the holistic world view of Vedanta. The 'morphic field', located in a particular body, proposed by Sheldrake, is connected with an universal field, according to David Bohm. "Moreover", writes Bohm, "such a field could not be located anywhere... When the explicate order enfolds into implicate order, which does not have any space, all places and all times are, we might say, merged, so that what happens in one place will interpenetrate what happens in another place."[90]

Other physicists have come forward to defend the new holistic world view. Like an Upanishadic Rishi another physicist Geoffrey Chew wrote in 1996 :

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89. F.A. Wolf: *Taking Quantum Leap:* P.177.

90. Sheldrake: *Presence of the Past:* P.306.

According to quantum theory, even if we do not talk, even if we do not look at each other, you affect me, and I affect you.... Your electron and my electron are only approximately distinguishable. In denying objectivity, quantum mechanics denies absolute status to your individuality. The only INDIVIDUAL is the entire universe."

"It was during his fifties, while I was applying Fermi's ideas to the structure of nuclear particles that I became aware that within every particle there is a sense in which every other particle resides. I was amazed that this essential aspect of quantum theory has not been emphasised by my teachers."[91]

According to Bell's theorem and Aspect's experiment, if hidden variables exist, they must act nonlocally. Bell's theorem thus devastates the local-cause, local-effect dogma of classical physics. The discovery of non - local, and non - causal connection between two similar particles brings the concept of non - local, non - causal determination. Milic Kapek calls it "neodeterministic interpretation of contemporary microphysics." Gary Zukav calls it 'Super-determinism' far beyond ordinary determinism.[92] *"According to Bohm, what happens in space-time is nevertheless determined by what happens in a nonlocal reality beyond space-time,"* says Rupert Sheldrake.[93] Such new ideas worried many scientists rooted in old materialistic ideas. **"The more the universe seems comprehensible, the more it seems meaningless," said the Nobel physicist Steven Weinberg at the conclusion of his popular book on cosmology. Amit Goswami comments: "We agree. Concepts such as nonlocal and unitive consciousness**

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91. Prabuddha Bharata (English Monthly: Mayavati Advaita Ashrama: August. 1996, P.103.
92. Gary Zukav: *The Dancing Wu Li Masters:* (N.Y. William Marrow & Co. 1979) P.318-19, 128.
93. Rupert Sheldrake: *Presence of the Past:* Times Book, U.S.A.; P.306.

and the idea of nonlocal collapse make the universe less comprehensible to the materialist scientist. These concepts also make the universe a lot more meaningful to everyone else."[94]

Psychologist Carl Jung coined the world *synchronicity* to describe meaningful coincidences that people sometimes experience, coincidences that occur without a cause except perhaps a common cause in the transcendent domain. "Synchronistic phenomena prove the simultaneous occurrence of meaningful equivalences in heterogeneous, causally unrelated process."

Vedanta says that no communication is necessary between two particles as both are floating on the background of *one universal mind and one universal consciousness.* "I have interpenetrated this universe, like a thread connecting pearls," says Krishna in the Gita. "O Gargi," says Yagnavalkya, "that one universal imperishable consciousness has penetrated everything in this universe," *(Br. Upanishad 3/8/11).*" Know that Atman which has interpenetrated the external and internal universe along with mind and vital energies. That is the way to immortality", says the Mundaka Upanishad. Vivekananda exposes in 1897 this holistic vision of life in his Madras lecture on *Work Before Us:* **"One atom in this universe cannot move without dragging the whole world along with it....The watchword and the essence have been preached in the days of yore when the Vedantic truth was first discovered, the solidarity of all life."**

The Holistic Paradigm : The New Paradigm of Science :

Aspect's experiments on Bell's Theorem where non-local consciousness communicates at a space - like distance, brings us nearer the Vedanta philosophy where a holistic consciousness

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94. Amit Goswami: *The Self-aware Universe:* P.130.

interconnects the Universe of both sentient and insentient. Following a successful verification of Bell's Theorem, David Bohm offers the idea of the universe of an 'unbroken wholeness', and an 'implicate order.' Henry Stapp writes on this discovery: **"An Elementary particle is not an independently existing analyzable entity. It is in essence a set of relationships that reach outward to other things."**[95] Michel Talbot writes on David Bohm's Theorem in his book *Beyond The Quantum:* **"Perhaps the most intriguing aspect of Bohm's theory is how it might apply to our understanding of the human mind. Bohm believes that such a mind-boggling interconnectedness might even shed light on the phenomenon of consciousness itself."**[96] Brian Josephson, winner of 1973 Nobel Prize in physics for his work on quantum tunneling and superconductivity, stated in a 1982 interview: **'It raises the possibility that one part of the universe may have knowledge of another part - some kind of contact at a distance under certain conditions.'**[97]

There is a growing conviction that this discovery of a fundamental interconnectedness of the universe will stand further tests. Physicist Fritjof Capra says: **"I believe the fundamental unity and the relatedness of the universe and the intrinsic dynamic nature of its phenomenon - the two basic elements of modern physics - will not be invalidated by future research."**[98] In biology the same holistic pattern is emerging clearer. Nobel Scientist Francis Crick speaks of the multidimensional function of a nerve cell or Neuron. He writes: **"One characteristic of a neuron is already fairly clear. A single neuron can fire at different rates and, to some extent,**

95. Fritijof Capra: *The Turning Point:* (Simon & Schuster) : P.81.

96. M. Talbot: *Beyond the Quantum:* P.52-53, 53-56.

97. Ibid: P.35.

98. Ed. Ken Wibler: *Holographic Paradigm and other essays: (Shambhala, 1992)* P.51.

tyles."[99] Karl Pribram's discoveries suggest the ıe single Holographic consciousness working in ..ɯı. "Brain is a hologram" Pribram concludes.[100]

"We are living in a single universe", says Illya Prigogine. Arthur Koestler coined a word, 'holon', to describe the sub-atomic particle, since each of them is inextricably connected with the rest of the universe. Each particle reflects the 'whole', as it were.[101] The movement of a single particle, is connected with the movement of all the particles in the system. Bohm calls it 'holo-movement'. Bohm has found it necessary to regard consciousness as an essential feature of the holo-movement and accepted it openly in his theory.[102]

These new findings and connections have led to the creation of a new 'paradigm', a new set of values in the world of science. The old Cartesian or Newtonian paradigm of a dualistic world vision, of a 'schizophrenic culture' of division between mind and matter, between matter and matter, is today replaced by the new paradigm - the 'Holistic Paradigm', as Ken Wilber calls it. This 'Holistic Paradigm' is only another name of the monistic or advaitic (non-dualistic) philosophy of Vedanta which India developed three thousand years ago. Hundreds of times this idea of unity comes out of Vivekananda's modern interpretation of the ancient Vedanta. Vivekananda spoke of the Vedantic idea of this unity of all beings in his speech on 'God in Everything', delivered in London in 1896.

> **"This is another great theme of the Vedanta, this oneness of life, this oneness of everything. We shall see how it demonstrates that all our misery comes through**

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99. Francis Crick: *The Astonishing Hypothesis.*
100. *Holographic Paradigm:* P.7.
101. Fritjof Capra: *The Turning Point:* P.43.
102. Ibid: P.96.

ignorance, and this ignorance is the obsession with manifoldness. The separation between man and man, between nation and nation, between earth and moon, between moon and sun. Out of this idea of separation comes all misery. But, the Vedanta says, this separation, does not exist, it is not real. It is merely apparent, the limitations imposed by the five instruments of knowledge man is bound with–the five sensory organs. In the heart of things, there is Unity still. And that Unity is God."[103]

Science seeks for a conscious Being behind the Universe: The Anthropic Principle.

Scientists recently developed the concept of a Human like (Anthropo) intelligence behind the Universe and guiding it. They call it 'Anthropic principle.' The Anthropic Principle was first coined in the mid-1970s by Cambridge astrophysicist Brandon Carter. Carter observed that the balance of power between the two forces gravitational, and strong interaction force is so incredibly fine-tuned that if the strength of the force of gravitation had varied by as little as a mere small part (1 part in 10^{40}), this delicate balance would have been destroyed and stars such as our Sun would never have formed.[104]

When David Overbye, the author of *Lonely Hearts of Cosmos*, drew a connection between blackhole and Indian Goddess Kali 'whose stomach is void," and 'whose womb is giving birth forever to all beings", Stephen Hawking did not give any importance. He said, "If you look through Eastern mysticism you can find things that look suggestive of modern physics or cosmology. I don't think they have any significance." In fact Hawking wanted to avoid any idea of God in science. Yet he had to accept such an idea when trying to explain the mysteries

103. *Complete Works:* Vol.2: P.125.

104. M. Talbot: *Beyond the Quantum:* P.184.

regarding the origin of the universe. He said, **"It is difficult to discuss the beginning of the universe without mentioning the concept of God. My work on the origin of the universe is on the underline between science and religion, but I try to stay on the scientific side of the border. It is quite possible that God acts in ways that cannot be described by scientific laws."**[105] Vedanta says that the cosmic creative Principle is Maya and the power of Maya acts in inscrutable (Anirvacaniya) ways. Today the Anthropic Principle is often associated with Hawking, along with Brandon Carter and other colleagues. Hawking believed there are laws that worked at the time that we call the beginning, or the Creation - that made our universe as it is today and not in some other form - and that we are capable of understanding them. He wanted to know what those laws are. Why, for example, is the speed of light 300,000 kilometers a second, rather than, say, 250,000 kilometers a second? Why does Planck's constant have the precise value it has, and not a little bigger or a little smaller? "If Planck's constant were not small the effects of quantum uncertainty would invade even our macro reality", says physicist Amit Goswami.[106] What would happen if gravity were weaker (or stronger)? Hawking points out that if the electric charge of the electron had been slightly different, stars wouldn't burn to give us light or wouldn't have exploded in supernovas to fling back into space the raw material for new stars like our sun or planets like earth. We live in a world that seems to be just right for life forms like us. The Anthropic Principle, in short, suggests that the Universe seems to be run by a transcendent intelligence.

Physicists turn to experience from experiments:

Speaking on 'The spirit of Science' at the *Eranos Tagung* held in Ascona in 1946, Erwin Schrodinger spoke about the

105. Michel White and John Gribbin: *Stephen Hawking:* P.167, 161.
106. Amit Goswami: *The Self-aware Universe:* P.36.

subject, the spirit inside us, which cannot be understood by law of the objective world. He said: "...the spirit is to an eminent degree subject, and thus evades objective examination." In defence of this stance, Schrodinger quoted (in translation) the opening line of Shankara's *Brahmasutrabhasya:*

> ***Subject and object - the 'I' and the 'not-I - are in Essence opposed to each other like light and darkness...***[107]

For Schrodinger, the phrase 'science of consciousness' is a mixture of contradictory elements of objectivity and subjectivity. Object can be *experimented* upon, subject has to be *experienced.* That is why Shankara asserted the idea that the presence of one Absolute Consciousness is an act of direct mystical experience or *Aparokshanubhuti*. "Religion is realization", says Swami Vivekananda. In Vedanta philosophy the realization of *I am the whole world or Aham Brahmasmi,* is the goal of human evolution. In Western tradition philosophy is intellectual confirmation of an idea. In Indian tradition, philosophy is the realization or vision of the idea (Darshan). All great philosophers of India spoke and preached only after themselves experiencing, and living the great principles which they realized. Like an Eastern mystic Schrodinger declared:

> **From the early great Upanishads the recognition ATMAN=BRAHMAN (the personal Self called the omnipresent, all-comprehending eternal Self) was in Indian thoughts considered far from being blasphemous to represent the quintessence of deepest insight into happenings of the world. The striving of all scholars of Vedanta was, after having learnt to pronounce with their lips, really to assimilate in their minds this grandest of all thoughts.**[108]

107. Ranjit Nair: *Mind, Matter and Mystery:* Ed. Scientica paperback, New Delhi, 2001: P.73-79.

108. Erwin Schrodinger: *My View of the World:* Cambridge Uni. Press: p.92.

With the same conviction in the Vedantic philosophy, Schrodinger wrote as early as in 1924, when quantum physics just started its century-long journey.

> **"This life of yours which you are living is not merely a piece of this existence, but in certain sense the 'whole' ...this, as we know, is what the Brahmins express in that sacred mystic formula which is yet so simple, so clear. TAT TWAM ASI. This is you. Or again in such words as " I am in the east, I am in the west, I am below and above. I AM THIS WHOLE WORLD".[109]**

Physicist Schrodinger's idea - *to assimilate this grandest of all thoughts* - was, according to F.A. Wolf, prophetic. Wolf says: "I like to think of this statement, "I am this whole universe," as the initial postulate of quantum thinking."

Like Schrodinger, Max Planck, the father of Quantum physics, raised similar questions in his book *Where is Science Going?* in which, according to *Observer*, Planck could "transcend the limits of his own scientific work and enquire into the philosophical implications." (Book cover) He wrote:

> **"Science cannot solve the ultimate mystery of nature. And that is because in the last analysis we ourselves are part of nature..."[110] Every advance in knowledge brings us face to face with the mystery of our own being.[111] All great scientific discoveries is backed by ....a definite drang or fundamental urge which seems to characterize the advance of physical science. In these cases, the**

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109. F.A. Wolf: *Taking the Quantum Leap:* P.182-187.

110. Max Planck: *Where is Science Going?* 9Green Allen And Union; London, 1933) P.217.

111. Ibid. P.169.

movement has undoubtedly been from the relative to the Absolute.[112]

Physicist Paul Davies speaks of the impossibility of knowing the absolute since the absolute includes the knower also:

"We cannot know Cantor's Absolute, or any other Absolute, by rational means, for any Absolute, being a Unity and hence complete within itself, must include itself. And here we encounter once more the Godelian limits to rational thought - the mystery at end of the universe."[113]

The Brhadaranyaka Upanishad (2:4:14) asks, "How to know the knower" *(Vijnataram aure Kena Vijnaniat)?* Nobel Physicist Richard Feynman took a similar visionary flight like Schrodinger on higher imagination. Intuition made him see the Reality through broad mystic overview, and inspired him to write:

Living things, masses of atoms, DNA, protein ... Dancing a pattern ever more intricate ... Out of the cradle onto the dry land ... Here it is standing ... Atoms with consciousness ... Matter with curiousity ... Sands at the sea ... Wonders at wondering ... I ... A universe of atoms ... An atom in the universe.[114]

Similarly another physicist Alan Wolf speaks like an Upanishadic mystic:

"A world without objectivity and locality would be a very subjective world. It would consist of one element: me. This is the world of the quantum solipsist. ... The world of the quantum solipsist bears some resemblance

112. Ibid: P.192-93.

113. Paul Davies: *Mind of God:* P.231.

114. F.A. Wolf: *Taking the Quantum Leap:* P.227.

> **to Descartes' "I think, therefore I am." A quantum solipsist says: I am the only reality. Everything out there is in my mind."**[115]

Einstein spoke about his own discoveries as "the years of anxious searching in the dark, with their intense longing, their alternations of confidence and exhaustion, and final emergence into the light."[116] His own turning away, from Mach's positivism to the 'intuitive leap' or 'Einstein's postulational method', turned him to search for the truth in the inner realm of mystic intuition free from the dogma of his own Jewish faith to which earlier he was genuinely committed.

As a scientist he spoke of the need of a "religious spiritualization of our understanding of life." He wrote: **"It seems to me that science not only purifies the religious impulse of the dross of anthropomorphism, but also contributes to a religious spiritualization of our understanding of life."** He became, as A.D. Reincourt pointed out, **"at heart an Eastern monist, as most scientists who are religiously inclined."**[117]

Transcending his own convictions that "the highest principles of our aspirations and judgements are given to us in the Judeo-Christian religious tradition,"[118] Einstein became a "Cosmic man", and turned towards the mystical. He wrote:

> **"The most beautiful emotion we can experience is the mystical. It is the power of all true art and science. He to whom this emotion is a stranger is as good as dead. To know that what is impenetrable to us really exists, manifesting itself as the highest wisdom and the most radiant beauty, which our dull faculties can comprehend**

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115. Ibid: P.223.
116. Brian Greene: *The Elegant Universe:* Concluding page.
117. A.D. Reincourt: *The Eye of Shiva:* P.190.
118. Einstein; *My View:* Rupa. Calcutta: 1967, P.65.

only in their most primitive forms - this knowledge, this feeling is at the center of true religiousness. In this sense and in this sense only I belong to the ranks of devoutly religious man."[119]

Swami Vivekananda's contribution towards the convergence of Science & Vedanta

Swami Vivekananda anticipated this culmination of Western physics in the concepts of Vedanta as early as 1895 when the new physics of this century had not even been dreamt of. At the Thousand Island Park in New York State he said:

"Modern science has really made the foundations of religion strong. Though an atom is invisible, unthinkable, yet in it are the real power and potency of the universe. That is what the Vedantist says of Atman."[120]

He further said:

Physics is bounded on both sides by metaphysics. So it is with reason - it starts from non-reason and ends with non-reason. If we push inquiry far enough in the world of perception, we must reach a plane beyond perception. Never can we give the reason for any fundamental principle.[121]

Vivekananda anticipated this holistic and mystical approach and hoped that modern science would take and turn from matter to the transcendental consciousness hidden in human beings, as the source of all existence.

"Religion is the science which learns the transcendental in nature through the transcendental in man. We know

119. Dialogue with Sager Scientists: Ed. Rane Weber: (Rontage and Kegan Paul), 1986. P.203.
120. *Complete Works of Swami Vivekananda:* Vol.7: Inspired talks.
121. Ibid: Vol.8. P.121-22.

as yet little of man, consequently but little of the universe. When we know more of man, we shall probably know more of the universe. Man is the epitome of all things and all knowledge is in him."[122]

Vedanta asserts that it is from pure consciousness that universe and life have emerged. Ken Wilber writes with the same conviction: **"The highest level does not violate the principles of the lower. It simply is not exclusively bound or is explainable by them".... "The higher transcends but includes the lower and not vice-versa. Thus, life transcends but includes matter; mind transcends but includes life; soul transcends but include mind, and spirit transcends but includes soul."**[123]

Vivekananda called Newton and Galileo **'Prophets of physical science'**, and the Upanishadic Rishis **'Prophets of spirituality'**, and declared that **"the whole universe mental and material will be fused into one."**[124] He also prophesied that any branch of knowledge, even physics, when properly followed would reach the same conclusions, which the explorations into the psychic - spiritual world would ultimately reach.

He said:

"In our country we go down on the knees before the man who reads the Vedas, and we do not care for the man who is studying physics, that is superstition; it is not Vedanta at all. It is utter materialism, with God every knowledge is sacred."[125]

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122. Ibid: Vol.8. P.20-21.
123. Ed. Ken Wilber: *Quantum, Questions* (Shyambhala: N. York. 1984) P.16.
124. *Complete Works of Swami Vivekananda:* Vol.6.; P.4.
125. Ibid: Vol.8.P.137.

Today the lastest explorations in different branches of science show how science is increasingly approaching the conclusions of Advaita Vedanta philosophy, and how such discoveries are turning scientists into philosophers.

This turning of science towards Eastern mysticism and Vedantic mysticism, A.D. Reincourt feels is due to the new interpretation of Vedanta by Sri Ramakrishna and Swami Vivekananda. He writes **"Can a connection between the scientific and mystical frames of reference be established over and beyond a certain metaphysical parallelism? The answer lies perhaps in the fact that Indian mysticism, at least as far as its leading representatives are concerned, has evolved as much in the past hundred years as the science of physics itself, in a direction that points towards an inevitable convergence of the two. From its modern awakening with Sri Ramakrishna and Swami Vivekananda, Eastern mysticism has begun to adapt its revelations to the entirely different cultural framework provided by science and technology, without in any way sacrificing what is valid in its traditional understanding of the phenomenon itself."**[126] A.D. Reincourt feels that this is **"perhaps the most outstanding cultural phenomenon of our times.**[127] **... Indian Mysticism has evolved as the science of physics itself."**[128]

The result of this confluence is ***'Orientalisation of the West'***, and more importantly a '**a new planetary culture**' in a holistic universe so powerfully confirmed by quantum physics. God has shifted His position from an extra terrestrial heaven to the inner realm of human psyche and this '**interiorisation of God**' or Christ or Buddha within all of us, is inspiring humanity to search

126. A.D. Reincourt: *The Eye of Shiva:* P.190.

127. A.D. Reincourt: *The Eye of Shiva:* P.183-84.

128. Ibid: P.23.

for happiness, peace, and fulfilment inside ourselves. Swami Vivekananda prophesied this convergence of modern science with monistic Vedanta and a consequent spiritualization of religion and civilization. **"Civilisation is the manifestation of divinity in man"**, Vivekananda declared to the Western thinkers in his Harvard lecture in 1895. A.D. Reincourt concludes:

> **"It might well be that mankind is now on the threshold of a psychological and physiological revolution of a magnitude that will overshadow all the social and political revolutions of our century. - made possible by the seemingly incongruous, yet perfectly logical marriage between science and Eastern mystical insights."**[129]

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124. *Co*
125. Ibid:

Princeton University **Department of Physics: Joseph Henry Laboratories**
Jadwin Hall
Post Office Box 708
Princeton, New Jersey 08544-0708

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Swami Jitatmananda
C/o. Publisher: S. **Ramakrishnan,**
Executive Secretary
Bharatiya Vidya Bhavan
Kulapati Munshi Marg
Bombay - 400007
India

Dear Swami Jitatmananda :

Many thanks for your kindness in sending me some time ago your new book. "Modern Physics and Vedanta." My wonderful mentor, Niels Bohr, had gone into deep interest into the Upanishads —more, he told me, in the questions than in the answers. I like to think that someone will trace out how the deepest thinking of India made its way to Greece and from there to the philosophy of our times.

The professor at Copenhagen whom Niels Bohr most admired, who was his teacher and subsequent occupant of the House of Honor that Bohr himself was to occupy, was Herald Hoffding. In an evening dialogue between Heisenberg and Bohr at that House of Honor about the uncertainty principle, Hoffding put his finger on the diagram between the double entrance slit and the terminating photographic plate and asked, "Where can the electron be said to be ?" Bohr's reply is immortal: "To be ? To be ? To be ? What does it mean, 'to be'?"

Your wonderful analysis of the great questions inspires us all in the great search that follows the spirit of the Upanishads, of Plato's dialogue and modern science.

Thank you again for your kind gift. Warm good wishes.

Sincerely

John A. Wheeler